IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF GEORGIA
ATLANTA DIVISION

C-E Minerals, Inc.,

Plaintiff and Counterclaim Defendant,

vs.

CARBO Ceramics Inc.,

Defendant and Counterclaim Plaintiff.

Civil Action No. 1:11-CV-2574-JOF

Declaration of David Gallagher

I, David Gallagher, pursuant to 28 U.S.C. § 1746(2), declare the following to be true and correct to the best of my personal knowledge and understanding:

1. I am over the age of 18 and competent to testify. If called to testify at any hearing I would swear to the truth of the matters set forth below.

2. I have personal knowledge of the facts recited in this declaration.

3. I am employed by CARBO Ceramics Inc. ("CARBO") as its Vice President of Marketing and Sales. I have served in this position at CARBO since April 2007.

4. In my current position at CARBO, my responsibilities include understanding the characteristics of proppants, understanding the needs

of end users and the manner in which proppants are deployed by them, recommending pricing of proppants manufactured by CARBO, negotiating contracts with customers, understanding and analyzing competition, including both the products which compete with CARBO's proppants and the other manufacturers which compete with CARBO for sales of proppants and understanding the overall economics of making and selling proppants worldwide.

5. Prior to working for CARBO, I worked at Schlumberger for more than twenty-six years. Schlumberger is known as an oilfield services company and, among other things, Schlumberger distributes a variety of products and services to oilfield operators and/or exploration and production ("E&P") companies. In connection with its services, Schlumberger is one of the world's largest purchasers of proppants

6. Hydraulic fracturing, or "fracking," refers to using pressurized fluids to create or extend fractures in the layers of rock beneath oil and gas wells in order to increase or extend recovery and production from those wells. Fracking includes the use of proppants to maintain the fracture after the fluid injection is halted. In simple terms, proppants, "prop" open the fractures.

7. While at Schlumberger, I served in a variety of positions that included everything from providing engineering solutions and field fracking of operating oil and gas wells to selecting and recommending proppants to be used in fracking operations to selling and marketing proppants to end users, and the purchase of proppants from manufacturers.

8. Through my long career in this industry I am familiar with the various proppants that are used in fracking. These include sand, resin-coated sand, lightweight ceramic proppants, intermediate weight ceramic proppants, and heavy weight ceramic proppants.

9. Regardless of the material used to manufacture proppants, proppants vary on several dimensions, including density, mesh size, shape, crush strength, conductivity and cost.

10. In lay terms, conductivity refers to the ability of a proppant to flow oil and gas through a pathway (e.g. fracture).

11. The most common proppants used in fracking throughout the world, including the United States, are sand-based (either sand or resin-coated sand).

12. Ceramic proppants, including lightweight proppants, directly compete with sand-based proppants, including resin-coated sand proppants.

13. Within ceramic proppants, lightweight ceramic proppants compete directly with intermediate weight ceramic proppants and intermediate weight ceramic products compete with heavy weight ceramic proppants.

14. CARBO manufactures and sells a variety of proppants, including resin-coated sand, a full line of lightweight ceramic proppants, intermediate weight proppants, and heavy weight ceramic proppants. Based on sales volume, CARBO sells more lightweight ceramic proppants than other types of proppants.

15. At CARBO and throughout the industry, competitors view proppants along a continuum of competing products and do not consider lightweight ceramic proppants as a distinct and separate market.

16. Purchasers of proppants express a similar view – that proppants are, for the most part, interchangeable products–and purchasers include sand, resin-coated sand, lightweight ceramic or intermediate weight proppants as among their viable alternatives when deciding on a proppant for fracking any particular well or field.

17. Throughout the years, CARBO has recognized the competition from sand-based proppants and has made this a major part of its marketing strategy. CARBO has promoted the advantages of ceramic proppants

over sand and resin-coated sand including its belief that lightweight ceramic proppants were better for the wells, were more efficient, and provided favorable benefits versus cost when compared to sand-based proppants. Although our promotional efforts succeed in some cases, the majority of potential users choose other proppants for their needs.

18. In recent years, CARBO has introduced the term "Economic Conductivity®" to the market, in which it encourages customers to overlay the economics of proppants with their conductivity when deciding what proppants to purchase for a given reservoir. Economic Conductivity® is defined as the incremental investment made by an E&P operator in higher quality proppant in the pursuit of a superior financial return achieved through an increase in production rates and elevated estimated ultimate recoveries.

19. I authored an article explaining Economic Conductivity® that was published in the Journal of Petroleum Technology, a leading trade publication, in April 2011. A true and correct copy of my article is attached to this declaration as Exhibit 1.

20. The hierarchy conductivity of various proppants can be depicted in a pyramid (see Exhibit 1), with sand at the bottom, resin-coated sand in the middle and ceramic proppants at the top, representing increasing levels of

conductivity. Generally, cost of proppants follows the same pyramid (with proppants at the top of the pyramid costing more than proppants at the bottom of the pyramid).

21. The underlying premise of Economic Conductivity® is that while some ceramic proppants may have a higher initial cost than other proppants (including sand), the appropriate choice should consider not just the proppant cost but the incremental production that derives from the use of a particular proppant over the lifetime of the well's production. In simple terms, this encourages a long-term cost-benefit analysis rather than a short-term cost-minimization strategy or buying based on an arbitrary budget, without regard to the ultimate production and recovery.

22. The market has responded favorably to the introduction of Economic Conductivity® as increasing numbers of proppant end-users are re-examining how they choose proppants in order to select the proppant that is best for a particular reservoir, given its geological characteristics, the physical characteristics of various proppants, the prices of proppants, and other assumptions about future prices of oil and gas.

23. To further illustrate how various proppants are viewed as potential substitutes for one another, one group of petroleum engineers from Hexion Specialty Chemicals, Inc. (now known as Momentive) studied

the use of sand, resin-coated sand and lightweight ceramic proppants in three reservoirs. This study was presented at the Society of Petroleum Engineers' Annual Technical Conference in Florence, Italy in September 2010. A true and correct copy of their paper is attached to this declaration as Exhibit 2.

24. The authors concluded from their tests that resin-coated sand (which is generally lower-priced than ceramic proppants) provided the most well production in the fields they studied due to specific reservoir and formation characteristics and that it outperformed lightweight ceramic proppants in these fields.

25. The concept of Economic Conductivity® makes all proppants potential substitutes for one another and causes manufacturers of proppants of all types to compete with one another.

26. Consistent with Economic Conductivity® and our understanding of how the market operates, most of CARBO's marketing efforts have been directed to E&P companies who are currently using sand or sand-based proppants for fracking – not customers who are already using ceramic proppants for fracking.

27. One of CARBO's most popular products is HYDROPROP®, a lightweight ceramic proppant. To illustrate how lightweight ceramic proppants compete with sand-based proppants, you need look no further than CARBO's marketing materials. CARBO compares the advantages of HYDROPROP® to "sand or resin-coated sand" and notes that it is "priced similarly to resin-coated sand." In fact, the marketing brochure for HYDROPROP® lists three advantages and two benefits of this particular lightweight ceramic proppant. Each of these five points directly references "resin-coated sands" or "white sand" or "sand." None of the marketing brochure references any competing lightweight ceramic proppants. A true and correct copy of the current marketing brochure for CARBOHYDROPROP® is attached to this declaration as Exhibit 3.

28. Similarly, CARBO's low-cost lightweight ceramic proppant, ECONOPROP®, is also marketed directly against sand-based proppants. The brochure for ECONOPROP® lists as a feature the fact that its physical characteristics (density and specific gravity) are "similar to frac sand" and it is promoted as "more cost-effective than resin-coated sand." A true and correct copy of the current marketing brochure for CARBOECONOPROP® is attached to this declaration as Exhibit 4.

29.Likewise, CARBOLITE® is another lightweight ceramic proppant manufactured and sold by CARBO. Again, the brochure for CARBOLITE® notes among the product features that its density and specific gravity are "similar to sand." A true and correct copy of the current marketing brochure for CARBOLITE® is attached to this declaration as Exhibit 5.

30.CARBO, as a publicly-traded company, must file annual reports with U.S. Securities and Exchange Commission ("SEC"). Part of its annual filing is includes a discussion of competition and competitors. A true and correct copy of excerpts from CARBO's 2010 Form 10-K filing discussing competition and competitors is attached as Exhibit 6.

31.Part of my job requires me to identify and monitor the activities of competing proppant manufacturers. Thus, I am familiar with the major manufacturers of the various proppant products and many of the smaller manufacturers throughout the United States and overseas.

32.CARBO is not alone in viewing resin-coated sand as a competing product to ceramic proppants. The manufacturers of resin-coated sand proppants acknowledge that they compete with lightweight ceramic proppants. For example, Santrol Proppants, a division of Fairmount Minerals Limited, Inc., is a global producer of sand-based proppants. It has both domestic (U.S.) and international manufacturing facilities. On its website, Santrol describes its resin-coated sand proppants as "lightweight ceramics alternatives." A true and correct copy of Santrol's website, as it appeared on October 4, 2011, is attached to this declaration as Exhibit 7.

33. Besides Santrol/Fairmont, other manufacturers of sand-based proppants with whom CARBO competes include Unimin Corporation, Badger Mining Corp., Ogelbay-Nortan Company, and Momentive (formerly known as Hexion Specialty Chemicals, Inc.). Each of them manufacturers and sells frac sand and/or resin-coated sand proppants in competition with CARBO, as disclosed in CARBO's 2010 Form 10-K.

34. Competition and substitution between and among lightweight ceramic proppants and resin-coated sand proppants is well known. For example, CARBO had been supplying large volumes of its ceramic proppant to support the project of an East Texas oil and gas operator for over three years. This business was recently lost to a competitor who supplied lower-priced resin-coated sand for that project.

35. Moreover, resin-coated sand is the fastest growing segment of the proppant market. In 2009, sales of resin-coated sand proppants approximately doubled, despite overall decreases in oil and gas activity.

Further, in 2009, CARBO lowered its prices for lightweight ceramic proppants by 10-15% in response to this increased competition during a period of reduced oil and gas activity.

36. CARBO, recognizing that resin-coated sand is an alternative to ceramic proppants and that customers are purchasing those proppants at an increasing rate, has itself begun to manufacture and sell resin-coated sand proppants in order to provide another price point for its customers and an alternative to ceramic proppants when Economic Conductivity® dictates the use of resin-coated proppants for a particular customer.

37. Ceramic proppants manufactured in one country may be exported to many other countries. CARBO produces lightweight ceramic proppants in the United States that are exported around the world. Its lightweight ceramic proppant, for example, is primarily made in Georgia and Alabama but exported to approximately 50 countries each year. Last year CARBO sold U.S.-made lightweight ceramic proppants as far away as Indonesia.

38. One of the world's largest producers of proppants is a French company called Saint Gobain Proppants. It produces and sells proppants all over the world in competition with CARBO. Additionally, it also has a domestic ceramic proppant manufacturing facility in Arkansas that has a

capacity for producing 400 million pounds of ceramic proppant per year. Saint Gobain has announced plans to expand its ceramic proppant capacity in Arkansas in 2012. Its Arkansas plant currently produces both lightweight ceramic proppants and intermediate weight ceramic proppants. Saint Gobain has also imported lightweight ceramic proppants into the United States from overseas production facilities.

39.Saint Gobain manufactures and sells an intermediate weight ceramic proppant called VersaProp®, which it markets on its website and throughout the industry as an alternative to "similarly priced economic lightweight ceramics." When VersaProp® was introduced by Saint Gobain, CARBO considered it a direct competitor to some of CARBO's lightweight ceramic proppants.

40.CARBO is also aware of at least 50 Chinese manufacturers of lightweight ceramic proppants, many of whom export lightweight ceramic proppants to the United States. In fact, CARBO has non-exclusive agreements with several Chinese ceramic proppant manufacturers under which they manufacture proppants according to CARBO specifications, which CARBO then imports into the United States and resells at a profit.

41. China Ceramic Proppant (Guizhou) Ltd. is one of the largest Chinese manufacturers of ceramic proppants, which sells under the trade name Pacific proppant. It, too, imports proppants into the United States and has a distribution network in North America. Its reported 2010 production capacity was 180 million pounds per year, with plans to expand by 50% in 2011. Guizhou is a competitor of CARBO.

42. Another significant Chinese ceramic proppant manufacturer, China GengSheng Minerals, Inc., publicly announced in July 2011 that it secured an order to ship $4.2 million worth of ceramic proppants (2.0 million pounds) from China to AMSAT International which were to ultimately be sold to AMSAT's North American oil and gas customers. This July 2011 order followed an earlier sale to AMSAT in December 2010 importing 2.6 million pounds of proppants into North America. China. GengSheng's reported capacity to manufacture ceramic proppants is 220 million pounds per year. China GengSheng is a competitor of CARBO.

43. Overall, published data of Chinese and Russian exports of ceramic proppants to the United States, which CARBO routinely monitors, show that approximately 1200 million pounds of ceramic proppant were imported into the United States in 2010. These imports exceed the

amount of all of CARBO's sales of ceramic proppants in the United States in 2010.

44. Mineracao Curimbaba ("Curimbaba") is a large Brazilian-based manufacturer of ceramic proppants which are distributed through the world. Sintex Minerals & Services is a Texas-based company that distributes Curimbaba ceramic proppants throughout North America. Among the products that Curimbaba sells through Sintex is "SinterLite", which is self-described by Sintex as "commonly used in place of lightweight and intermediate weight ceramics." Curimbaba is a competitor of CARBO.

45. CARBO's 2010 Form 10-K specifically acknowledged Saint Gobain is one of its largest competitors, along with Curimbaba. It further identified several of CARBO's lightweight ceramic proppants as competing with ceramic proppants from Saint Gobain and Curimbaba and "with sand-based proppants."

46. CARBO's 2010 Form 10-K also reports numerous foreign competitors who manufacture and export intermediate and lightweight ceramic proppants from Russia and China.

47. There is also no dearth of new entry of competitors who manufacture, or plan to manufacture, lightweight ceramic proppants domestically.

a. Oxane Materials is a new entrant into the proppant market. It recently opened a facility in Van Buren, Arkansas from which it manufactures and sells lightweight ceramic proppants. It has already announced plans to expand its production capacity. Oxane Materials is a competitor of CARBO.

b. Shamrock Proppants is another ceramic proppant manufacturer that received approval in May 2011 to construct a new $75 million plant in Wellsville, Missouri to manufacture lightweight ceramic proppants. This amount of investment is typical for a plant of approximately 200 million pounds of annual stated capacity. Shamrock is a competitor of CARBO.

c. Texas-based Pyramax Ceramics, LLC, too, recently announced plans to build a plant in Georgia to manufacture and sell lightweight ceramic proppants in the Unites States. It has secured $155 million in funding for its startup, which is typical for a proppant plant with 400 million pounds of annual stated capacity. Pyramax is a competitor of CARBO.

I expect further announcements by other entrants of plans to begin manufacturing and selling lightweight ceramic proppants in the United States, as well as expansions and increases in capacity by existing competitors.

48. C-E's publicly-announced facility for manufacturing lightweight ceramic proppants in Georgia has a stated capacity in excess of 200 million pounds (100,000 tons) per year. I am familiar with the economics of manufacturing and selling lightweight ceramic proppants. I would conservatively estimate that a new entrant like C-E, if it manufactures a quality ceramic proppant that is competitively priced, should be able to obtain net profits of at least $.05 per pound sold.

49. C-E reports having sold, on an advance basis, all its production capacity. Conservatively, this would generate a minimum of $10.0 million in profits (200 million pounds times $.05/lb) per year for C-E. In reality, because C-E has direct access to kaolin from its own nearby stockpiles and mines, which is the primary cost driver for ceramic proppants, C-E could potentially earn profits one-and-a-half times that level each year.

50. With more than two years remaining on its restrictive covenant (ending December 31, 2013), if C-E were to manufacture and sell ceramic proppants beginning in the fourth quarter of 2011, I would estimate that

C-E would earn profits of at least $20 million and potentially as high as $30 million over the remaining two plus years of Section 5.

51. When I have made presentations at CARBO concerning the competitive landscape, I have included a discussion of challenges posed by the increases in resin-coated sand capacity and its increasing share of the proppant market, a discussion of international producers of ceramic proppants, including Chinese- and Russian-made proppants, as well as US-based competitors who make and sell ceramic proppants, including lightweight ceramic proppants.

52. PropTester, Inc. is a third party vendor that conducts market and industry research of the proppant market. It makes available the results of its research to subscribers. CARBO subscribes to PropTester's service. CARBO (and others in the industry) consider PropTester to be a reliable source for market-based information, including sales estimates by geographic region and segmented by product category. I am familiar with PropTester's studies and reports, which are regularly maintained by CARBO in its marketing files and used and relied upon internally by CARBO.

53. Published data from PropTester estimates global consumption of proppants was about 38.6 billion pounds in 2010. Of this total, sand

proppants (raw sand and resin-coated sand) comprised more than 34.2 billion pounds (about 89%). In 2010, about 4.35 billion pounds of ceramic proppants were consumed (about 11% of the proppant market). In 2010, ceramic proppants' market share of all proppants declined from 2009.

54. As of 2010, CARBO's domestic manufacturing facilities had the stated capacity to produce 1,285 million (i.e., 1.29 billion) pounds of ceramic proppants per year. Its international facilities in China and Russia had stated capacity for an additional 200 million pounds of ceramic proppants per year, yielding a total stated production capacity of 1485 million (i.e., 1.49 billion) pounds per year as of 2010.

55. Thus, CARBO's total 2010 stated ceramic proppants capacity could supply only about 4% of the 2010 worldwide demand for proppants (1.5 billion out of 38.6 billion). If one considers only global demand for *ceramic* proppants (4.35 billion pounds) – CARBO's 2010 worldwide stated capacity of ceramic proppants would only account for 34% (1.49 billion /4.35 billion) of that global demand.

56. Industry-wide, global capacity to produce ceramic proppants was estimated at almost 6 billion pounds per year in 2010. Consequently,

CARBO's stated capacity of ceramic proppants is just 25% of worldwide capacity of ceramic proppants by all manufacturers.

57.If sales figures are limited only to proppants sold *in the United States*, I estimate that CARBO's 2010 sales of proppants in the United States were about 3% of overall sales of proppants in the U.S.

58.Finally, if sales figures are further limited only to *ceramic* proppants sold in the United States, I estimate that CARBO's 2010 sales of ceramic proppants in the United States were approximately 34.1% of this universe.

59.In 2010, PropTesters estimates that more than 800 million pounds of ceramic proppants were imported into North America by Chinese manufacturers. CARBO's worldwide ceramic production is not much larger than this amount, at 1,485 million pounds.

60.Our internal estimates are that CARBO's market share of the global proppant market has declined by more than a third since 2008. We attribute this decline to several factors, including the increase in competition from other ceramic proppant manufacturers, the faster growing increase in sales of resin-coated sands, and the expiration of some of CARBO's patents in 2006 and 2009. If sales outside the United

States are excluded, CARBO estimates that its share of proppant sales to U.S. customers has declined by more than 10% over the same period due to substitution and increased competition.

61. Santrol, for example, had reported capacity to produce between 2 and 3 billion pounds of resin coated sand in 2010 and its 2011 capacity was projected to reach 4 billion pounds annually. Resin-coated sand is one of the primary competing products for CARBO's lightweight ceramic proppants and Santrol's estimated 2011 capacity would be more than twice CARBO's stated capacity of ceramic proppants.

62. As reported in its 2010 10-K filed with the SEC, between 23 and 29% of all of CARBO's sales in the last three years have been outside the United States.

63. Pricing of ceramic proppants depends on a number of factors, including the market prices for oil and gas (which can increase or decrease the amount of fracking being undertaken and drive demand for proppants), the costs of transporting proppants from the point of manufacture to customers, the prices of competing proppants, including sand-based proppants, changes in end user preferences, the number of foreign and domestic manufacturers, increases in industry capacity, and the need to maintain long-term relationships with customers.

64.CARBO sells its proppants to service organizations, who act as distributors to end users. There is a relatively small number of such service organizations–approximately a dozen or so–who purchase a substantial amount of the proppants sold worldwide. As a consequence, each of those customers tends to wield significant purchasing power and leverage with proppant manufacturers. CARBO's pricing of ceramic proppants is constrained by the need to nurture long-term relationships with large customers.

65. Because of the risk of significant substitution with other proppants and the presence of powerful customers, I would not advocate any attempt by CARBO to institute a non-transitory 5 percent price increase for its lightweight ceramic proppants that was not fully justified by increased costs because I do not believe that such a price increase would be profitably sustained.

66.The oil and gas industry is highly cyclical, based on fluctuations in the prices of oil and gas, and this affects the demand for proppants. When oil and gas prices drop significantly, the demand for proppants suffers significant declines as well. It is during such down cycles that proppant buyers will take retribution on manufacturers who previously instituted large unjustified price increases during cycles when demand was high and supply was short. CARBO fears such buyers would withhold purchases from manufacturers who attempted unjustified short term price increases. Consequently, the cyclical nature of this industry, coupled with the structure of the market (i.e. dominated by a few large buyers), prevents any individual manufacturer, including CARBO, from profitably sustaining large price increases over the long term.

67.CARBO has not restricted output or constrained its capacity for ceramic proppants. To the contrary, as reported in its 2010 Form 10-K, CARBO "has consistently expanded its manufacturing capacity and plans to continue its strategy of adding capacity."

68.In recent years, CARBO has entered into two supply contracts with service organizations in which each of those companies has agreed to purchase a certain percentage of their ceramic proppant needs from CARBO. I was personally involved in negotiating both of these contracts, neither of which requires the service organizations to actually make purchases from CARBO.

69.One of those supply contracts is with Halliburton and a redacted version of that contract was filed with CARBO's quarterly report on Form 10-Q for the period ending September 30, 2008. An amendment to this contract was filed with CARBO's quarterly report on Form 10-Q for the period ending March 31, 2011. A true and correct copy of that agreement, as filed with the SEC, is attached to this declaration as Exhibit 8.

70. Pursuant to this supply agreement, Halliburton agreed to purchase a specified portion of its global ceramic proppants needs from CARBO. Worldwide, Halliburton's purchases of ceramic proppants from CARBO accounted for more than 10%, but less than 40% of CARBO's 2010 revenues.

71. Halliburton is free to purchase sand or resin coated sand as a substitute for purchasing ceramic proppants without affecting its purchase percentage. Thus, the Halliburton's contract only precludes it from purchasing more than a specified percentage of ceramic proppants to avoid breaching the CARBO contract. Substitution of sand-based proppants for ceramic proppants by Halliburton will not affect its ability to satisfy its contract with CARBO. Note that Halliburton consumes close to 1.5 billion pounds a month of proppant in the United States; of that amount CARBO supplies less than 5 %.

72. In any supply agreement that includes minimum purchase requirements, CARBO would ordinarily be entitled to recover its lost profits if a buyer failed to purchase the agreed minimum, as measured by the shortfall in

the volume of agreed purchases times CARBO's profit per unit. However, in the Halliburton contract, in lieu of such lost profits in the event that Halliburton did not meet its contractual minimum, the parties agreed on a liquidate damages provision. The liquidated damages which Halliburton is contractually obligated to pay if it does not purchase the minimum percentage specified, is given on a per pound basis. In other words, for each pound below the agreed purchase target that Halliburton falls, it agreed to pay a specified amount as liquidated damages.

73. The per pound amount of the liquidated damages was a negotiated item with Halliburton. Due to Halliburton's bargaining power, the per pound amount of liquidated damages is significantly *less* than CARBO's actual lost profits per pound.

74. In other words, if Halliburton were to breach its minimum requirements contract with CARBO, it has negotiated a favorable liquidated damages provision whereby its payment to CARBO would be much less than CARBO would otherwise be entitled to receive as compensatory damages. Thus, in the absence of the liquidated damages provision, Halliburton's potential liability for breaching the contract with CARBO would be greater. This allows Halliburton to purchase from other

suppliers, with minimal cost from breaching its CARBO contract, if the other suppliers provide sufficient price savings.

75.Halliburton's 2010 U.S. purchases from CARBO pursuant to the supply contract approximated less than 2% of all proppants sold in the United States by all manufacturers and less than 20% of all ceramic proppants sold in the United States by all manufacturers.

76.CARBO's other percentage-based supply contract is with a major oilfield services company. The contract only obligates them to purchase from CARBO a certain percentage of alumina-silicate lightweight ceramic proppants that they buy. The customer is free to purchase lightweight ceramic proppants with other formulations from CARBO's competitors (including magnesium-silicate lightweight ceramic proppants manufactured by Fores, a competitor). In other words, the customer may replace CARBO's lightweight ceramic proppants with those of its competitors without violating the contract.

77.Thus, because of the narrow scope of the specifications, this customer can continue to purchase lightweight ceramic proppants from other manufacturers, as long as they are outside the product specifications, without any impact on its obligations with CARBO. In other words, it can freely substitute a number of other ceramic proppants for those which it has agreed to purchase from CARBO and not result in a breach of the supply contract. CARBO believes that this customer purchases a majority of its ceramic proppant needs from CARBO's competitors.

78. Regardless of whether this customer chooses to purchase X pounds of ceramic proppants meeting the contract specifications, or 100X pounds, it satisfies its obligations to CARBO as long as it purchases the agreed percentage. It does not have to purchase any minimum number, however.

79. Likewise, this customer is free to purchase resin coated sand as a substitute for purchasing ceramic proppants meeting the contract specifications without affecting its purchase percentage. Thus, the contract only precludes it from purchasing more than a specified percentage of lightweight ceramic proppants falling within a narrowly described product specification, a specification that does not cover all lightweight ceramic proppants, to avoid breaching the CARBO contract.

80. This customer's 2010 US purchases from CARBO constituted approximately less than 1% of all proppants sold in the United States by all manufacturers and less than 6% of all ceramic proppants sold in the United States by all manufacturers.

I declare under penalty of perjury that the foregoing is true and correct.

David Gallagher

Executed on October 13, 2011
Houston, Texas
United States of America

Exhibit 1 to

Declaration of David Gallagher

GUEST EDITORIAL

The Hierarchy of Oily Conductivity

David G. Gallagher, Vice President, CARBO Ceramics

David G. Gallagher was appointed vice president of CARBO responsible for global marketing, sales, and strategy in 2007. He has more than 30 years of experience in oilfield services. Gallagher, who started his career as a field fracturing engineer, has served in various senior managed roles in the areas of strategy, marketing, and stimulation technology development. He has extensive international business management experience and worked for more than 10 years in Latin America. He earned a bachelor of engineering degree from the University of New Mexico.

In 2010, the US petroleum industry accomplished a feat that not many thought was possible only a few years ago—annual production of crude oil on American soil rose two consecutive years for the first time in almost 25 years. This is incredible, considering the battering this industry suffered during the 2008 financial crisis.

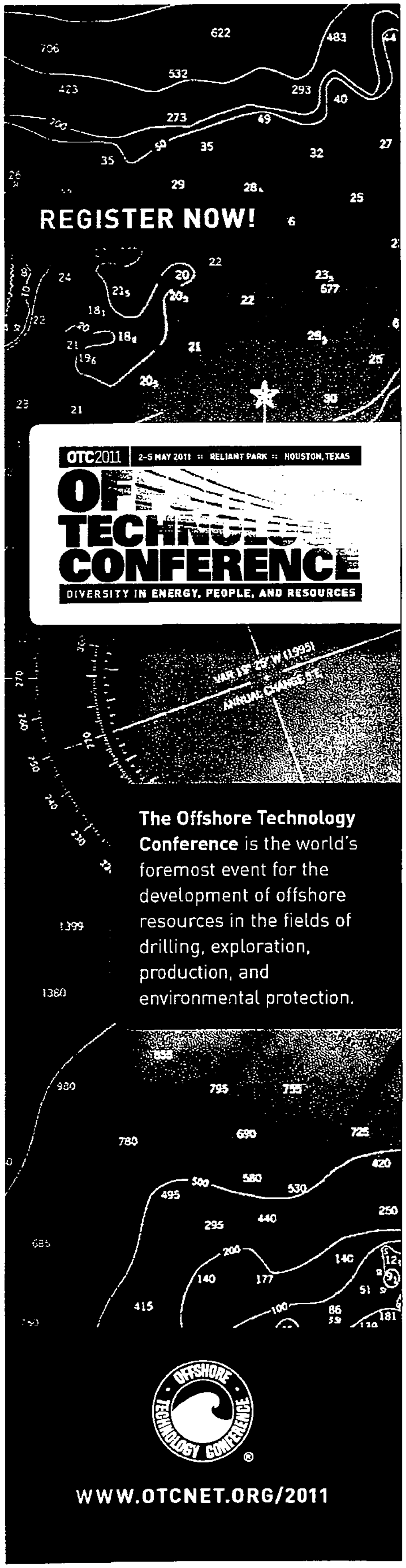
The sustainability of this achievement likely will depend on successful economic exploitation of a handful of oil-rich resource plays, all of which will require hydraulic fracture stimulation. These fracs provide conductive paths from the wellbore to the fracture surface area in the formation. However, in most reservoirs fractures are known to collapse if not sufficiently propped. The induced conductivity is intended to convert the wells to successful economic ventures. Economic conductivity principally will be provided (or not) through the type and quality of proppant employed.

A simple way to define economic conductivity is "the incremental investment made by an E&P operator in higher quality proppant in the pursuit of a superior financial return achieved through an increase in production rates and elevated EURs." When the price of oil is north of USD 50/bbl, the internal rate of return tends to increase rapidly for a nominal incremental investment in conductivity.

The benefits of increased conductivity have been documented in more than 200 SPE technical papers. Enhanced return on investment has been achieved in all types of reservoirs. From shallow to deep, from North Dakota to south Texas to the Far East, oil and gas investors have been rewarded for following good engineering practices and banking on conductivity.

The history of proppant use in the field of hydraulic fracturing is well known. The search for higher strength proppant was initiated in the mid-1970s by E. Claude Cook of Exxon Production Research, and resulted in a patented hydraulic fracturing method using sintered bauxite. Ceramic proppant was born. Curable resin-coated sands were introduced in 1975 to reduce flowback of critical propping materials, and pre-cured resins were soon applied to sand to encapsulate crushed sand particles and prevent migration and the resulting loss of conductivity. For many decades, though, the utilization of high quality proppant was mainly limited to deep, hot, vertical gas wells. Increased usage was noted in 2003, when the price of natural gas pushed through the USD 4/MBTU level. As the economics of natural gas production improved, the employment of higher quality proppant, especially ceramics, increased. This industry trend continued steadily from 2003 through 2007. What occurred next changed the proppant industry permanently.

By 2008, several oil and gas operators had begun experimenting with fracturing long horizontal sections in the natural gas bearing Haynesville formation located in north Louisiana and east Texas. Most experts recognized that to maximize the area contacted by the wellbore, hydraulic fractures would need to be purposely designed to propagate transversely from the horizontal wellbores. However, transverse fractures provide only a limited intersection with the wellbore, resulting in tremendously high produced fluid velocity within the proppant pack. These phenomena increased the need for obtaining maximum fracture conductivity which in turn catapulted the usage of ceramic proppant.



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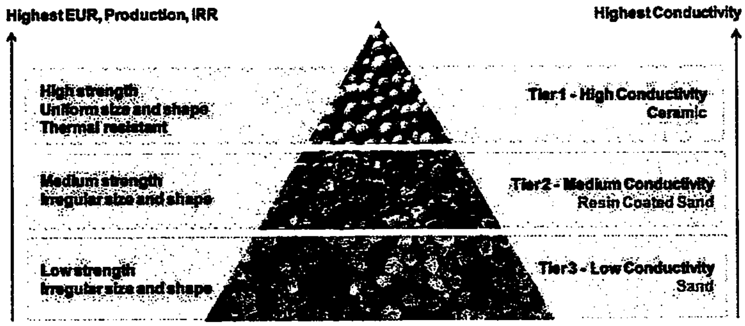

Fig. 1—The hierarchy of conductivity.

In the past, a "typical" 10,000 ft vertical well would be fracture treated in about three stages, consuming around 600,000 lb total. With the onset of efficient directional drilling techniques came the enormous opportunity to expose more rock surface to be stimulated. Proppant requirements quickly rose above 2,500,000 lb per well as the number of frac stages increased fivefold. As the drilling rig count in this area increased, the supply of quality ceramics soon became scarce. Resin-coated sand (pre-cured) was introduced as a lower cost (albeit lower conductivity) substitute for ceramic proppant when necessary. At this point horizontal drilling in the oil-rich Bakken/Three Forks resource play had already begun, and its multiphase fluid production needed higher conductivity, while the nominal price of oil was taking a monumental leap.

As recovery from the 2008-2009 industry crisis began, E&P companies began to take a closer look at the cost/benefit ratio of increased conductivity **(Fig. 1).**

The pyramidal shape illustrates the pecking order of proppant. Tier 1 (ceramics) provides the highest conductivity and the best well productivity due to the strength, uniform size, and shape, and the inherent thermal resistance of a man-made proppant; tier 2 (resin-coated sand) provides moderate conductivity and has moderate strength, but is somewhat irregular in shape and size; tier 3 (uncoated sand) provides the lowest conductivity due to diminished strength combined with asymmetrical size and shape.

As one would suspect, the hierarchy of conductivity also follows a hierarchy of cost: the higher the conductivity of the proppant, the higher the investment. The issue, however, is whether the increased investment in a higher tier proppant leads to a higher return on investment. The topic is really that simple. Divergence from this concept sometimes leads to proppant decisions being made to fit the authorization for expenditure vs. fitting what maximizes profitability of the well. Early production figures may seem adequate; however, over time basic chemistry and physics principles always prevail. Ideally from an economic standpoint, a well would be fractured only once in its lifetime, provided that the economic benefits justified this approach. The scientist and the financial manager alike know that the application of best reservoir practices and sound investment economics are not necessarily mutually exclusive.

The pursuit of creating optimal economic conductivity for a particular reservoir will not end with today's greatly improved practices. Innovation will bring us closer to the perfect proppant as reservoir conditions become more challenging. Radioactive isotopes will be replaced by non-radioactive tracers. More will be learned about actual proppant placement, perhaps through far-field detection. Proppant will be invented that can withstand the harshest of environments.

The renaissance of US production is an exciting phenomenon enabled by novel engineering applied in a fiscally correct manner. Economic conductivity will continue to provide a bright path for the future of hydraulic fracturing and assist in sustaining this remarkable rejuvenation. Efficient technology transfer should accelerate the application of this model in the international resource plays. **JPT**

Exhibit 2 to

Declaration of David Gallagher

SPE International

SPE 135502

Proppant Selection and Its Effect on the Results of Fracturing Treatments Performed in Shale Formations

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Abstract

Since the introduction of hydraulic fracturing, the industry has been attempting to establish laboratory testing parameters that assist operators and service companies in their effort to select the optimum proppant for a particular field application. An example of this effort is the development of the "long-term baseline conductivity laboratory test" for proppants. While this test is a huge leap forward in subjecting proppant to simulated downhole conditions, it still does not adequately address many additional factors that can impact the effectiveness of the proppant such as:

1. Proppant fines generation and migration in the fracture
2. Proppant resistance to cyclic stress changes
3. Proppant embedment in the fracture face
4. Proppant flowback and pack rearrangement in the fracture
5. Downhole proppant scaling

Most proppant choices are currently based on which one has the highest baseline conductivity, cost, and availability. While this approach seems logical, it runs the risk of overlooking or under-valuing other critical factors effecting proppant performance in downhole environments.

To better define what constitutes the most effective proppant for a particular application, field cases will be presented that focus on the impact of proppant selection in a number of wells completed in various shale formations. The analysis will examine the production history associated with a variety of proppant choices. In an effort to better understand the production results, a series of lab tests will be performed on the proppants utilized in the field cases. These tests will attempt to establish how these factors (such as proppant fines, cyclic stress, embedment, proppant flowback, and scaling) could be used to explain and support the results of the field cases.

Introduction

This paper reviews a number of fracturing treatments performed in three active areas in the United States; the Fayetteville Shale in Arkansas, the Bakken Shale in North Dakota, and the Haynesville Shale in north Louisiana. Reservoir characteristics, proppant type, and post fracture treatment production results were examined in each area. The proppants compared in this study were routinely utilized in the three areas. They are, in the Fayetteville, uncoated frac sand (UFS) and curable resin coated sand (CRCS); in the Bakken, uncoated frac sand, lightweight ceramic (LWC), and curable resin coated sand; and in the Haynesville, lightweight ceramic and curable resin coated sand.

The hypothesis of this study is that due to the reservoir and formation characteristics in the three areas, CRCS with its grain-to-grain bonding technology should provide higher downhole fracture conductivity (FC) leading to increased post fracture treatment well production.

To verify the hypothesis, laboratory tests outside the traditional long-term baseline conductivity were conducted with proppants and formation core samples from each area. The objective was to more accurately simulate proppant performance under specific downhole conditions of temperature, pressure, fluid, and rock properties pertaining to each area.

Proppant fines generation and migration, as well as proppant flowback were studied in the Fayetteville Shale. In addition, the term effective conductivity (EC) is introduced as an improvement over the traditional reference or baseline conductivity. Effective conductivity is a more realistic measurement of a proppant's performance under downhole conditions where high fracture flow velocities cause proppant fines to migrate and reduce pack permeability. In the Bakken Shale, proppant fines and embedment were studied. And finally, proppant pack cyclic stress, embedment, and scaling were examined in the Haynesville Shale.

We examined the combined effects of all these factors on downhole fracture conductivity and resulting post fracture treatment well production in the three specific reservoirs. Based on laboratory tests, literature research, and discussion with operating and service company personnel, we assigned a weighting to each factor with data in the FC calculation in each area. A statistical analysis was performed in each shale area comparing post treatment well production and proppant type utilized. We then calculated a fracture conductivity correlation (FCC) to quantify the correlation between well production and fracture conductivity factors.

The analysis shows that in the three shale areas studied, there is a correlation between proppant types pumped, proppant performance under more realistic laboratory tests, and the corresponding post treatment well production. The study also confirms the hypotheses that curable resin coated sand (CRCS) outperform both uncoated frac sand (UFS) and lightweight ceramic (LWC) in the areas studied.

Proppant Selection Factors Studied

Proppant Fines Generation and Migration

Proppant fines are the small particles that break off of the proppant grain when they are subjected to fracture closure stress. Small broken pieces of proppant grains reduce pack porosity and permeability. Proppant fines cause major degradation in the conductivity of proppant packs. Coulter et al. (1972) conclude that just 5% proppant fines reduce proppant pack conductivity by 62%. These results are similar to Lacy et al. (1997) showing only 5% fines causing 54% reduction in proppant pack conductivity. When proppant fines migrate down the proppant pack towards the wellbore, they accumulate and reduce proppant pack flow capacity even more.

Nolte (1988) states that the fracture closure stress on proppant is equal to the minimum in-situ stress of the formation. Wang (2005) shows that fracture closure stress on proppant can be calculated by multiplying the fracture gradient by the depth of the middle perforation. As downhole temperature and fracture closure stress increases, proppants begin to crush and create fines. Broken proppant grains cause reduced fracture width and reduced hydrocarbon flow to the wellbore. These small particles also migrate throughout the proppant pack, reducing proppant pack permeability and conductivity.

Standard tests such as API RP-56, API RP-58, API RP-60, and ISO 13503-2 commonly used for measuring proppant fines do not simulate the wet, hot conditions found in a propped fracture (Freeman et al. 2009). These tests are conducted with dry proppant at ambient temperature and closure stress for only two minutes. None of these test conditions are realistic for any propped fractures. Diep (2009) and Freeman et al. (2009) describe a modified API/ISO crush resistance test procedure that more realistically represents downhole conditions. Using this procedure significantly increased the occurrence of proppant failure. Percent fines of a lightweight ceramic (LWC) proppant increased more than fivefold using this modified procedure compared to the standard procedure (Freeman et al. 2009). **Fig. 1** shows typical fines generated from a LWC proppant. Palisch et al. (2009) argue that using various modified crush test procedures result in a percentage of fines much lower than generated from a 50-hour conductivity test. Their crush test data actually show that using a wet environment results in percentages of fines closer to the 50-hour conductivity test compared to the other modified crush test procedures tested.

We used a similar procedure as Freeman et al. (2009) and conducted wet, hot crush tests on various proppants. Prior to standard crush testing, proppants are exposed to representative downhole conditions for 24 hours. Results show that resin coated sand (RCS) is less susceptible to the creation of fines. The resin coating encapsulates proppant fines as shown in **Fig. 2** and keeps the fines from migrating through the proppant pack, reducing proppant pack permeability. Underdown et al. (1985) show that resin coating does in fact encapsulate sand grains, resulting in a similar percentage of fines compared to uncoated sintered bauxite after exposure to 10,000 psi closure stress.

Fig. 1—Scanning Electron Microscope (SEM) photo (404x) of 40/80 mesh lightweight ceramic proppant fines after a wet, hot crush test at 10,000 psi.

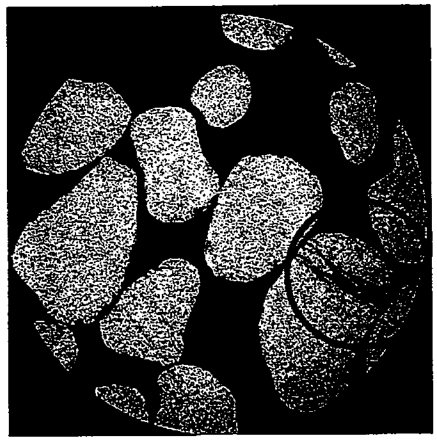

Fig. 2—Encapsulation of proppant fines with resin coating as seen by a CAT scan of CRCS after a wet, hot crush test at 10,000 psi. Grain-to-grain bonding with resin is also shown.

Proppant Pack Cyclic Stress

When comparing proppants, one factor often overlooked is a proppant's performance under closure stress changes. The forces of cyclic stress that are exerted on proppants downhole can cause them to fail. Events often occur multiple times throughout the life of a well such as shut-ins due to workovers, connections to a pipeline or possible shut-ins due to pipeline capacity that lead to cyclic changes in fracture closure stress. This varying amount of pressure and stress can cause the proppants to shift or rearrange, resulting in a decrease in fracture width as well as additional proppant fines and proppant flowback. These changes cause proppants to be exposed to much more extreme conditions than a routine baseline or reference conductivity test simulates.

Holditch et al. (1992) conclude repeated stress cycles significantly reduce proppant pack conductivity and fracture width while increasing the amount of fines. Kim et al. (1987) discuss that shut-ins of fracture stimulated wells result in lower production following the shut-in due to lower fracture conductivity and decreased fracture width. Freeman et al. (2009) report the percentage of fines of LWC proppant increased nearly tenfold to 22.6% after only four stress cycles. Rickards et al. (1998) conclude that stress cycles on sand increase fines percentages and decrease proppant pack permeability. Lacy et al. (1998) conclude that proppant embedment will increase and fracture width will decrease after each stress cycle on the proppant pack due to well shut-ins.

Cyclic stress often causes uncoated sand and ceramic proppant to fail due to the variable amounts of pressure exerted on them. CRCS resists these cyclic stress changes by forming a bonded, flexible lattice network that redistributes the stress through the proppant pack. These strong proppant packs are the best solution to withstanding the effects of cyclic stress. The proppant remains intact in the fracture as intended to keep the pathway to hydrocarbon open. The cycling of the closure stress applied to the proppant pack can be damaging to most proppant types although not to the same extent. For uncoated proppant, cycling the closure stress can significantly increase proppant grain failure and the accompanying generation of fines. For precured RCS (PRCS), it can increase grain failure, but to a lower degree than in the uncoated case. CRCS create grain-to-grain bonds that are resistant to cyclic stress variations. Vreeburg et al. (1994) conclude that stress cycles increase proppant flowback from wells and CRCS with at least 80 psi unconfined compressive strength (UCS) can withstand at least 25 stress cycles without producing proppant. Anderson et al. (2002) show that CRCS prevents proppant flowback even after 30 stress cycles. Rickards et al. (1998) conclude that adding resin beads to proppant reduce the detrimental effect stress cycling has on proppant pack conductivity.

Effective Conductivity

Barree et al. (2003) conclude that reference conductivity data are optimistic; actual fracture conductivity is much lower than expected; and proppant conductivity should be considered with all damage effects under downhole conditions included. Reference or baseline conductivity is often used to predict how much hydrocarbon can flow through a proppant pack. Typical reference conductivity lab tests are run at a low flowrate of only 2 ml/min (0.1 ft^3/D per perforation) which does not simulate realistic downhole flow conditions. This method of measuring conductivity does not exert real-world conditions on the proppant that causes fines migration. McDaniel et al. (1992) conclude the low flow rate of a typical conductivity test masks the true effect of proppant failure and the subsequent migration of fines generated. This paper also shows that increasing the flow rate in conductivity tests cause significant permeability loss due to fines migration. High pressure, temperature, and flow rate downhole causes proppant fines to migrate and severely decrease fracture conductivity. Without fines included as part of the equation, reference conductivity results simply do not accurately represent true downhole conductivity.

Even though the currently used long-term conductivity test does not tell the realistic story for effective fracture conductivity, it does simulate the effects of bottom-hole temperature (BHT), applied closure stress, and a wet environment. However, long-term conductivity tests do a poor job of documenting the effects of fines migration, whether those fines are generated from failed proppant grains or the formation fracture faces. Gidley et al. (1995) show that increasing the flow rate in a conductivity test resulted in fines migration that decreased UFS permeability by 74%, decreased LWC proppant permeability by 23%, and decreased PRCS by only 10%.

The wet, hot crush test procedure includes a wet, hot environment which provides more realistic conditions to measure the effect of fines and provide more accurate conductivity results. The heat, moisture, and pressure applied more closely simulate the downhole conditions that are likely to create proppant fines. When conductivity is measured with the fines included, more accurate proppant performance results are attained.

The wet, hot crush test provides a clear picture of the tendency of a particular type of proppant to resist grain failure under realistic bottom-hole conditions. It should not provide a better estimate of grain failure than a long-term conductivity test; assuming the wet, hot crush test and the conductivity test are run the same length of time. There should be no difference in the ability to apply realistic temperature and stress conditions for either of the tests. The key to converting reference conductivity to effective conductivity is in long-term conductivity test procedures. If the test procedure includes no periods of stress cycling or increased flow rates to mobilize generated fines, the measured conductivity will be greatly overstated. If the test procedure does address pressure cycles, surges in flow rate, and the effects of proppant embedment, then the measured conductivity will more closely match what can be expected downhole. This is assuming that there is no significant conductivity damage that is the result of the fracturing fluid used to create the fracture and place the proppant.

To incorporate the effect of downhole proppant fines, effective conductivity is calculated using the Coulter et al. (1972) method to reduce the published reference conductivity. It is stated that, only 5% fines can cause a 62% reduction in proppant pack conductivity. Fines generation and migration have a direct effect on the expected proppant pack conductivity. The downhole performance of proppant changes significantly once fines are factored into the equation. **Fig. 3** shows how published reference conductivity is reduced by the detrimental effect of fines resulting in more realistic effective conductivity. CRCS increases effective conductivity by reducing fines generation and fines migration.

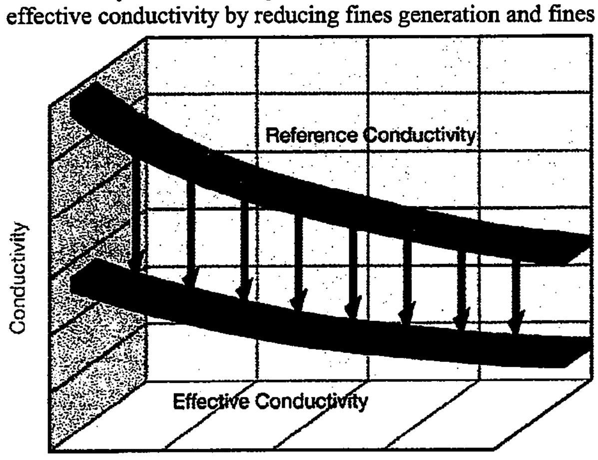

Fig. 3—Effective conductivity is calculated using the Coulter et al. (1972) method to reduce the published reference conductivity.

Proppant Flowback and Pack Rearrangement

Vreeburg et al. (1994) conclude that proppant flowback from fractured wells leads to high operational costs, compromise safety, preclude the use of unmanned platforms, and can only be prevented by the use of CRCS. Proppant flowback is a leading cause of well production decline, equipment damage, and well shut-ins for repairs. Uncoated or precured RCS can flow back out of the fracture and into the wellbore as the well is produced as shown in **Fig. 4.** The higher the flow velocity results in a higher likelihood of proppant flowback. Proppant flowback can cause damage to downhole tools as well as surface equipment. In horizontal wells, flowback of uncoated proppant can deposit along the lateral. All of these issues lead to expensive repairs and cleanouts.

Proppant flowback can also cause loss of near wellbore conductivity and reduced connectivity to the reservoir. CRCS has grain-to-grain bonding (**Fig. 5**) that eliminates proppant flowback, if applied properly, by forming a consolidated proppant pack in the fracture. This grain-to-grain bonding occurs downhole under a combination of reservoir temperature and closure stress after the fracture closes. Browne et al. (2003) conclude that CRCS is the most effective method to prevent proppant flowback and increase production compared to other proppant flowback methods. Anderson et al. (2002) show that CRCS prevents proppant flowback in high temperature, high rate gas wells in south Texas. Peard et al. (1991) conclude that CRCS prevents proppant flowback and results in increased oil production compared to wells completed with uncoated proppant in the AWP (Olmos) field. Johnson et al. (2005) conclude that CRCS prevents proppant flowback in low temperature Permian Basin wells.

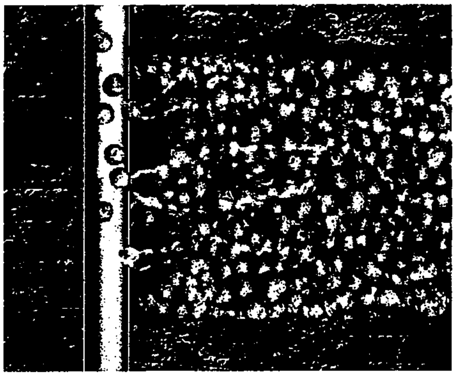

Fig. 4—Proppant flowback from the fracture into the wellbore can occur with uncoated proppant or precured RCS.

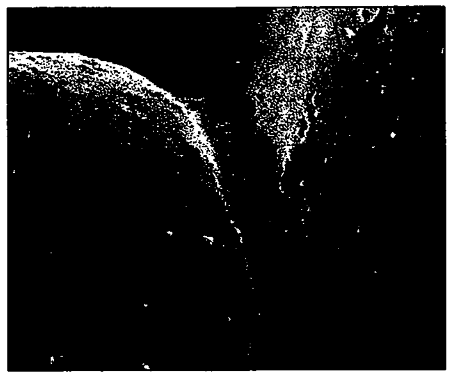

Fig. 5—SEM photo (651x) of CRCS grain-to-grain bonding that eliminates proppant flowback by forming a consolidated proppant pack in the fracture.

Many laboratory tests conducted by researchers have evaluated how to prevent proppant flowback. Parker et al. (1999) show that adding resin to proppant provides up to a twentyfold increase in critical fluid velocity required to erode proppant from a simulated fracture. Nguyen et al. (2003) show that CRCS prevents proppant erosion from an API conductivity cell even at high flow rate and with stress cycling. Weaver et al. (1999) show that adding resin to proppant greatly increases the critical fluid velocity required to erode proppant from a fracture perforation model. Vreeburg et al. (1994) conclude that CRCS with at least 80 psi UCS can withstand at least 25 stress cycles without producing proppant from an API conductivity cell. Anderson et al. (2002) show that CRCS prevents proppant flowback from an API conductivity cell even after 30 stress cycles.

After proppant flowback, the proppant remaining in the fracture can rearrange (**Fig. 6**) and allow the fracture to close. This can have a drastic effect on propped fracture width and connectivity to the wellbore which reduces the flow of hydrocarbon to the wellbore. In addition, microfractures that are propped open may close completely. Volk et al. (1981) conclude that when the proppant coverage drops below 50% of a monolayer in shale formations, the fracture will close due to embedment. CRCS with grain-to-grain bonding keep the proppant grains from shifting, which keeps the fractures propped completely open. This bonding technology provides additional proppant pack integrity, enhanced fracture flow capacity, and increased long-term production of the well (Nguyen et al. 2008). **Fig. 7** shows commonly available proppants with only CRCS forming a consolidated pack.

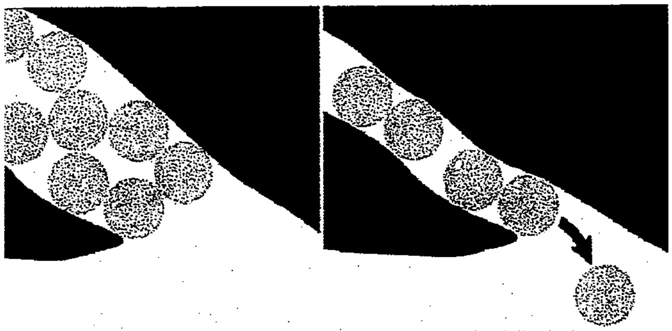

Fig. 6—Proppant pack rearrangement can occur with uncoated proppant causing reduced fracture width and microfracture closure.

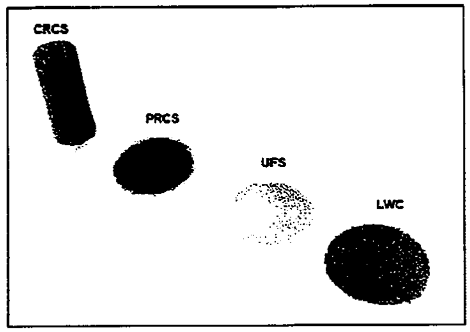

Fig. 7—Samples of commonly available proppants with only CRCS forming a consolidated pack under downhole conditions.

Proppant Embedment

Proppant embedment is another serious issue that reduces fracture width and conductivity. Proppants can embed into the fracture face especially in soft shale formations as shown in **Fig. 8**. Proppant embedment leads to reduced fracture width and lower fracture flow capacity (Penny et al. 1987). CRCS has less embedment into the formation compared to uncoated proppant because CRCS grains bond together forming a consolidated proppant pack that redistributes closure stress resulting in less embedment. Penny et al. (1987) state that a curable resin coating on proppant reduces embedment by redistributing stresses on the proppant pack within the fracture. This paper shows that the embedment profile of CRCS is noticeably different compared to uncoated sand and ceramic proppant due to the bonded grains distributing the load along the core face, resulting in much less embedment. This paper also shows the embedment crater of ceramic proppant is five times wider and deeper than the embedment crater for the same size CRCS.

An additional issue associated with proppant embedment is the creation of formation fines (spalling) which can migrate and cause additional loss of fracture conductivity. See **Fig. 9.** Lacy et al. (1997) conclude that proppant packs are significantly damaged due to formation fines caused by embedment. Their data show only 5% formation fines reduce proppant conductivity by 54%. Weaver et al. (1999) and Blauch et al. (1999) show that formation fines can reduce proppant pack conductivity up to 96%. As proppant embeds into the shale fracture face under bottom-hole stress conditions, formation fines are generated. LaFollette et al. (2009) show that Haynesville Shale core has a major decrease in Brinell hardness of greater than 73% after exposure to broken fracturing fluid. This softening of Haynesville Shale will increase proppant embedment and decrease proppant pack conductivity.

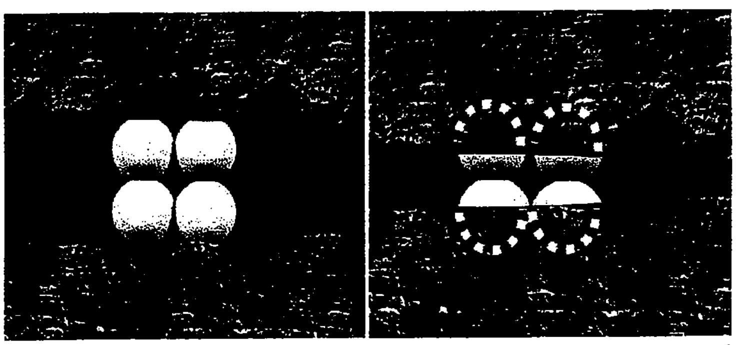

Fig. 8—Proppant embedment into the fracture face reduces fracture width and conductivity.

Figure 9—SEM Photo (514x) of formation fines spalling (circled) due to grain embedment.

Downhole Proppant Scaling

A geochemical reaction commonly known as proppant scaling or proppant diagenesis can occur downhole in the fracture. LaFollette et al. (2010) conclude that scaling occurs on ceramic proppant in the presence of Haynesville Shale and that ceramic proppant grain strength decreased by nearly half with and without the presence of Haynesville Shale. Weaver et al. (2008) conclude that ceramic and bauxite proppant packs can lose as much as 90% permeability due to proppant scaling. This paper also concludes that when ceramic and bauxite proppants are exposed to downhole fracture conditions, proppant dissolution and subsequent re-mineralization of clay-like aluminosilicate minerals form in the proppant pack pore spaces. The aluminum comes from the ceramic and bauxite proppant, and the silicate comes from the formation. This crystalline material is similar to formation fines, plugging the porosity and permeability of the proppant pack which reduces proppant pack conductivity. This reaction normally occurs slowly in shallower formations with less extreme conditions such as shales. However, the process accelerates under the high pressure, high temperature (HPHT) conditions found in many shale formations. Weaver et al. (2009) show that bauxite proppant grain strength is reduced up to 70% after exposure to downhole fracture conditions.

Weaver et al. (2008) conclude that adding a resin coating to proppant greatly reduces proppant scaling. The resin coating provides a hydrophobic layer that prevents water from dissolving the proppant surface and forming scale. Weaver et al. (2005) conclude that ceramic proppant scaling can lead to significant loss of proppant pack permeability and that resin coated proppant has reduced scaling, providing improved long-term conductivity as shown by improvements in production decline rates. Underdown et al. (1985) show that resin coated proppant have virtually no weight loss in high temperature neutral pH water compared to sand and bauxite proppant. Weaver et al. (2006) conclude that ceramic proppant promotes scaling and resin coated proppant prevents scaling. Lab tests show that under conditions simulating a downhole environment, resin coated proppant exhibit no scaling while uncoated ceramic proppant forms porosity-plugging mineral scale. The resin forms a barrier around the substrate grain that prevents water from reacting with the proppant grain surface and forming scale in the proppant pack pore spaces. The effects of scaling can occur slowly, but as long-term exposure increases, production decreases more rapidly due to the detrimental effects. **Fig. 10** shows the results of scale tests. Scale formed on the LWC proppant while no scale formed on the CRCS. Test conditions were at 300°F for 15 days under 3,000 psi closure pressure using a Haynesville shale core and simulated Haynesville water.

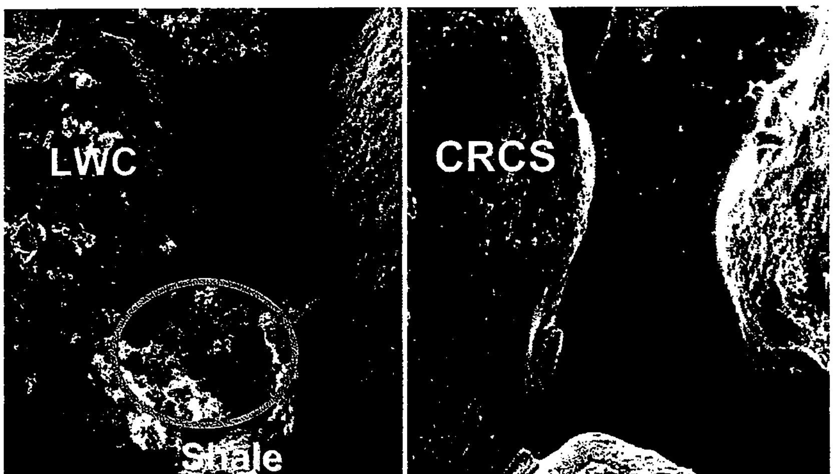

Fig. 10—Scale formed on LWC proppant (left) and no scale formed on CRCS (right). Red circle shows pit hole in LWC proppant. Green circle shows scale in pore space between LWC and Haynesville Shale.

Fracture Conductivity

Fracture conductivity (FC) is dependent on proppant pack permeability and proppant pack width (Barree et al. 2003). Factors effecting proppant pack permeability include proppant fines, formation fines from embedment, and proppant scaling. Proppant pack permeability decreases as the amount of each of these factors increases. Factors effecting proppant pack width include proppant embedment, proppant flowback, and frac fluid filter cake damage. Proppant pack width decreases as the amount of each of these factors increases.

Well production after fracture stimulation is dependent on FC among other reservoir factors. Maintaining high FC in the proppant pack is crucial to long-term enhanced well production. This can be accomplished by reducing the detrimental effect these factors have on FC.

A weighting for each factor with data for the FCC in each area was assigned for the well's production as an example in **Table 1**. The only major difference between fracture treatments was the proppant; therefore the well production difference should be a function of the FC difference. We used a correction factor (Φ) that adjusts for unknown factors such as proppant flowback and pack rearrangement, and proppant scaling. Other factors not considered were non-darcy flow, multiphase flow, multiphase non-darcy flow, gravity and viscous segregation, and reservoir flow capacity (Barree, et al. 2003).

Active Shale Play Analysis

Fayetteville Shale

A comprehensive review of Fayetteville fracture treatment designs and core data along with numerous discussions with operating company and fracturing company personnel was conducted. The additional proppant selection factors of proppant fines generation along with proppant flowback and pack rearrangement were seen relevant to the Fayetteville Shale fracture treatments.

The Fayetteville Shale is part of the Arkoma Basin. It is a gas shale that runs from the Oklahoma side of Arkansas to the Mississippi river. Its thickness ranges from 150 to 300 ft and contains large amounts of silica and fine sediment. The heart of the Fayetteville Shale is in White County, Arkansas. The Fayetteville covers roughly 4,000 square miles.

Well depths vary broadly from approximately 1,500 to 7,000 ft. Lateral lengths typically run between 3,000 to 4,000 ft. Bottom-hole temperatures range from 100 to 150°F with an average fracture closure stress of 6,000 psi (FG = 1.1 psi/ft) or less. Wells flow at an initial production (IP) averaging one to three million cubic ft (MMcf) per day and decline at a lesser rate than in other shale plays.

Most of the wells in this play are horizontals with an average of six to ten frac stages. Frac treatments generally are slickwater using 300,000 to 400,000 lbm of proppant, with concentrations stepping from 0.1 up to 2.2 lbm/gal. Pump rates range from 80 to 100 bbl/min.

While the reservoir and rock characteristics in the Fayetteville were previously thought to only require the use of UFS, literature research shows that proppant fines and migration along with proppant pack rearrangement should be investigated to potentially improve fracture treatment results. In addition, field reports indicate that proppant flowback is a problem throughout the area. It contributes to additional operating expenses, well downtime, and loss of near-wellbore connectivity to the fractured reservoir leading to lower well production. Based on these three factors, a CRCS should provide increased well production and lower operating expenses in the Fayetteville Shale.

Laboratory tests and literature research were conducted comparing a 40/70 mesh UFS with a 40/70 mesh CRCS simulating Fayetteville Shale well conditions and completion procedures. Production results were studied on 13 wells in the Fayetteville Shale comparing the two proppant types.

Fracture Treatment Production Results Comparison CRCS versus UFS

Fracture treatments on 13 wells were compared in White County, Arkansas. All the wells had similar characteristics and completion techniques. Seven of the wells utilized 100% 40/70 mesh UFS while six wells had 10% tail-ins using a 40/70 mesh CRCS. The average CRCS proppant volume was approximately 400,000 lbm per well (40,000 lbm per stage). The average four month cumulative gas production for the CRCS wells was 26% higher than the UFS wells. See **Fig. 11.** The incremental cost for CRCS proppant for each well was recovered on average within the first two months of production. Reduced proppant flowback and less well downtime for cleanouts were also reported.

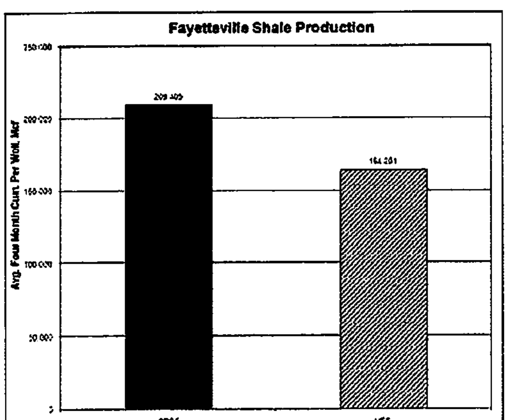

Figure 11—Fayetteville Shale production increase comparison of 40/70 CRCS and 40/70 UFS.

Proppant Fines

A wet, hot crush test was performed comparing 40/70 UFS to 40/70 CRCS. At a fracture closure stress of 5,000 psi and a temperature of 200°F, UFS exhibited 8.8% fines while the CRCS showed no fines. See **Fig. 12.**

Effective Conductivity

Based on Coulter et al. (1972), with 8.8% fines at 5,000 psi, the UFS has a 77% reduction in reference conductivity from 483 to 112 md-ft effective conductivity. Due to zero fines generation, the CRCS has zero reduction in reference conductivity; therefore effective conductivity equals reference conductivity, 622 md-ft. See **Fig. 13.**

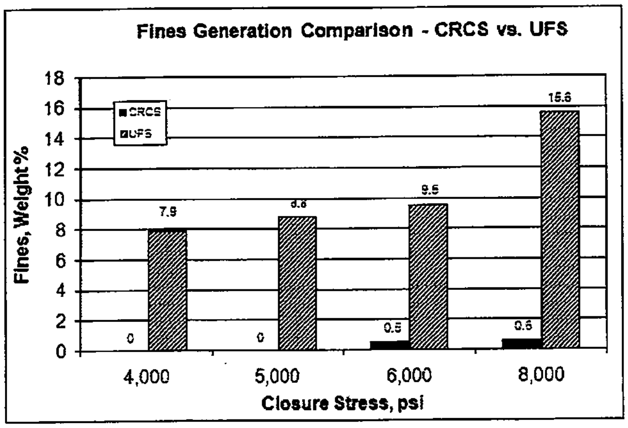

Figure 12—Wet, hot crush test results comparison of 40/70 CRCS and 40/70 UFS.

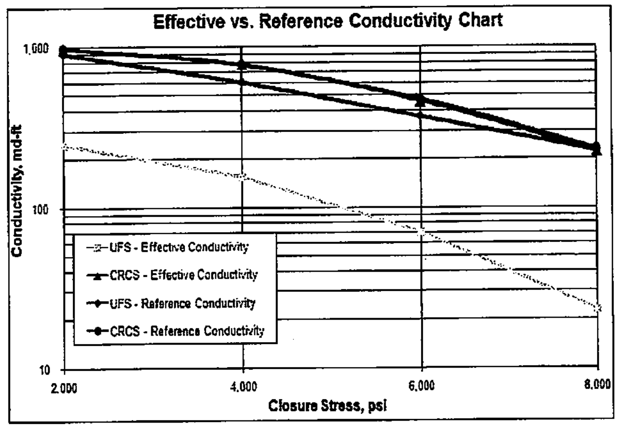

Figure 13—Effective versus reference conductivity comparison of 40/70 CRCS and 40/70 UFS.

Proppant Flowback

Discussions with Fayetteville Shale operating and service company personnel reveal that post treatment proppant flowback into the horizontal lateral is prevalent. This proppant flowback is caused by higher flow velocity converging near the wellbore. It is also due to fracture walls not fully closing on the proppant pack as the well is produced. While it is known that special surface equipment and lateral cleanouts with coiled tubing are often required, the exact effect of proppant flowback on downhole fracture conductivity and well production is not known at this point in time.

Proppant Pack Rearrangement

The Fayetteville Shale is naturally highly fractured and it is thought that part of the area's fracturing success is from connecting these natural fractures as well the creation of additional microfractures or offshoot fractures during the treatment. The 40/70 proppant grains (mean particle diameter averaging 0.32 mm) can prop open these microfractures and improve the downhole fracture conductivity. Highly curable (greater than 90%) CRCS has shown in the lab to adhere to a formation core sample. This feature reduces the probability of pack rearrangement and microfracture closure as the well is produced. However, the effect of proppant pack rearrangement on downhole fracture conductivity and well production is not known.

Fracture Conductivity Correlation

The FCC equation for the Fayetteville Shale is:

$$\Delta PI = \Delta EC / \Phi_4$$

The four month production increase for the CRCS wells versus the UFS wells is a function of the difference in EC plus other unknown factors (Φ) such as proppant flowback and pack rearrangement.

$$26\% = (316\% \times 10\%) / \Phi_4$$

Φ_4 = 1.2 for Fayetteville Shale FCC. See **Table 1.**

Table 1 FCC for Fayetteville Shale

	Proppant Type			
Factor	UFS	CRCS	Difference	Comment
Proppant type utilized	100%	10%*	10%	*10% CRCS tail-in, 90% UFS
Effective Conductivity (EC)	222 md-ft	924 md-ft	316%	2,500 psi, UFS = 6.7% fines, CRCS = 0% fines
Production Increase (PI)			26%	Four month cumulative well production difference

Bakken Shale

The Bakken is an oil shale in the center of the Williston Basin occupying roughly 200,000 square miles of North Dakota, Montana, and Saskatchewan, Canada. The Bakken is divided into three sections; the upper and the lower separated by the middle sandy shale. The majority of the wells drilled in the United States Bakken are horizontal 8,500 to 10,000 ft laterals at vertical depths up to 10,000 ft. Closure stresses generally range up to 9,500 psi depending on depth and location.

Recent fracture treatment designs have been hybrid slickwater using linear gel followed by a crosslinked gel system. Typical well completions involve 25-30 fracture stages or more per lateral pumped at rates of 30-40 bbl/min at 6,000-8,000 psi. Typical proppant volumes average 75,000 to 100,000 lbs per stage with 40/70 mesh lead-ins and 20/40 mesh tail-ins. As this is an emerging horizontal play, operators are continually testing different proppants while looking for an effective, economical completion strategy. UFS and LWC proppants have been most common until early 2009. Wiley et al. (2004) report using CRCS in Bakken completions with greater than 6,500 psi closure stress to ensure ample fracture conductivity.

Fracture treatment production results were studied on 16 wells in the Bakken. In addition, proppant fines and embedment were studied in relation to these wells.

Fracture Treatment Production Results Comparison

CRCS versus UFS

A study was conducted comparing the productivity of 16 Bakken wells in Dunn and McKenzie County, North Dakota fractured with CRCS and UFS. The test group consisted of five wells using CRCS and the remaining 11 wells used UFS. All wells had similar vertical depths, lateral lengths, and similar completion techniques. The average first month cumulative oil production for the CRCS wells was 23% higher than the UFS wells while the average two month cumulative oil production for the CRCS wells increased to 35% higher. See **Fig. 14.**

Proppant Fines

The amount of proppant fines generated after a wet, hot crush test was measured for CRCS, LWC, and UFS. **Fig. 15** shows results of these tests; CRCS has the lowest amount of fines followed by LWC.

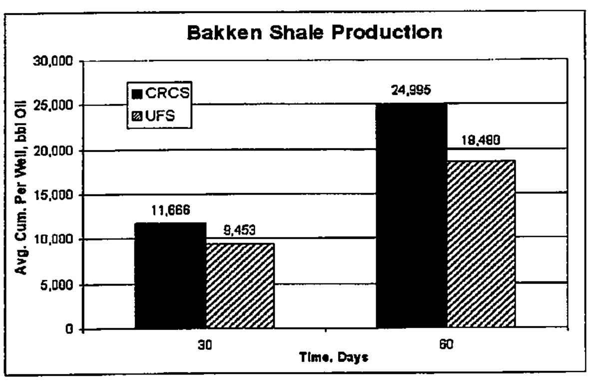

Figure 14—Bakken Shale production increase comparison of 20/40 CRCS and 20/40 UFS.

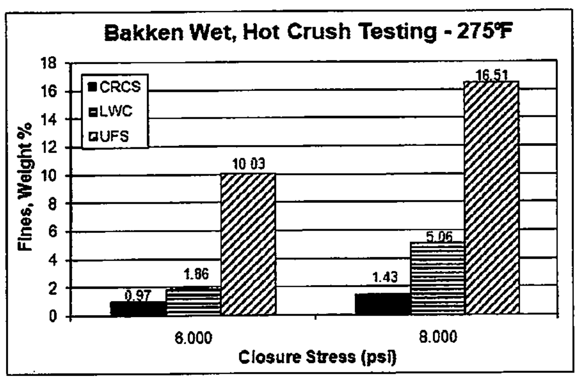

Figure 15—Wet, hot crush test comparison of 20/40 mesh CRCS, LWC, and UFS.

Proppant Embedment

Until recently, proppant embedment in the Bakken formation was not documented. Loeffeler (2010) stated that embedment is an issue in the Bakken. Our findings show embedment occurs in Bakken core as shown in **Fig. 16.** LWC had more than 2.5 times the embedment depth into the Bakken formation core compared to CRCS. We also determined the amount of formation fines generated from embedment as shown in **Fig. 17** by using the mean particle diameter and embedment depth for each proppant tested. The amount of formation fines from embedment is much less for CRCS compared to LWC and UFS.

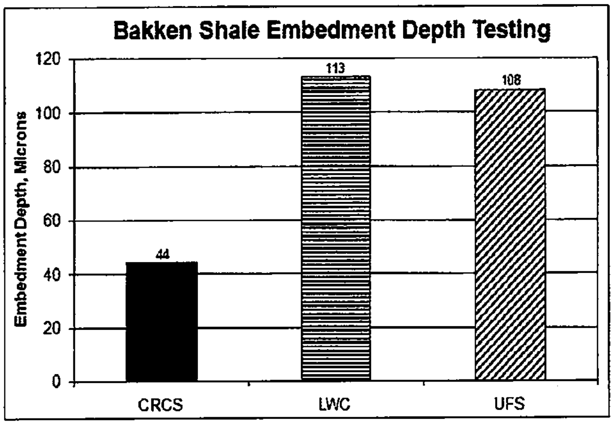

Fig. 16—Bakken Shale embedment depth with 20/40 CRCS, 20/40 LWC, and 20/40 UFS after five days at 275°F and 8,500 psi closure stress.

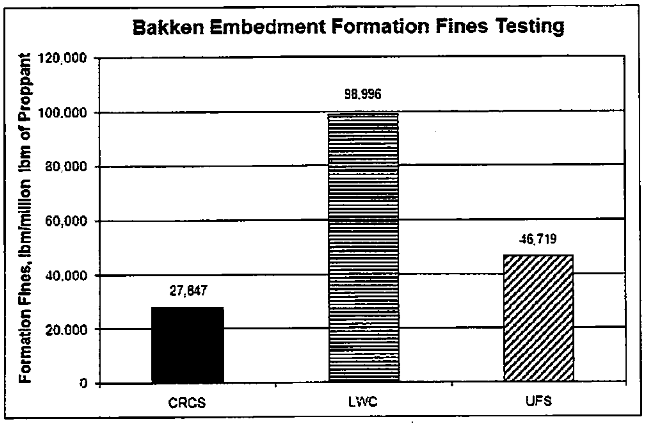

Fig. 17— Formation fines generated from Bakken Shale embedment with 20/40 CRCS, 20/40 LWC, and 20/40 UFS after five days at 275°F and 8,500 psi closure stress.

Fracture Conductivity Correlation

The FCC equation for the Bakken Shale is:

$$\Delta PI = (\Delta EC / \Phi_2) + PE$$

The two month production increase for the CRCS wells versus the UFS wells is a function of the difference in EC and PE plus other unknown factors (Φ_2) such as proppant flowback, pack rearrangement, and proppant scaling.

$$35\% = (88\% / \Phi_2) + 9\%$$

$\Phi_2 = 3.4$ for Bakken Shale FCC. See **Table 2**.

Table 2 FCC for Bakken Shale

	Proppant Type			
Factor	**UFS**	**CRCS**	**Difference**	**Factor**
Effective Conductivity (EC) – Two month average stress	2,017 md-ft	3,796 md-ft	88%	4,000 psi, UFS = 3.6% fines, CRCS = 0.5% fines
Proppant Embedment (PE) – Width at maximum stress	5,524 microns	6,008 microns	9%	Increase in frac width due to less embedment at 2 PPSF with CRCS, % change is same between 4,000 psi and 8,500 psi
Production Increase (PI)			35%	Two month cumulative average well production difference

Haynesville Shale

The Haynesville Shale is located primarily in northwest Louisiana and runs into east Texas and southern Arkansas. The Haynesville formation is a gas shale with typical measured depths of 14,000 to 18,000 feet. True vertical well depths (TVD) in the Haynesville Shale typically range from 10,000 to 13,000 ft with 4,000 ft laterals or longer. Closure stress ranges from 9,000 to 12,000 psi and bottom-hole temperatures reach 325°F or more. This makes the Haynesville one of the deepest shale plays in North America with HPHT (high pressure, high temperature) well conditions.

Improving the fracturing treatment results in the Haynesville is a continuous focus. The prevailing treatment design is slickwater with 10 to 15 stages per lateral pumped at rates up to 80 bbl/min averaging 300,000 to 400,000 lbm of small mesh proppant. Hybrid slickwater variations are also pumped which include crosslinked gels and larger mesh proppant tail-ins. It has generally been found that more frac stages and larger proppant volumes lead to higher production.

Fracture treatment production results were studied on 16 wells in the Haynesville Shale. In addition, proppant pack cyclic stress resistance, proppant embedment, scaling, and effective conductivity were examined in relation to these wells.

Fracture Treatment Production Results Comparison

CRCS versus LWC

All the fracture treatments were completed on wells in DeSoto Parish, Louisiana. All wells had similar characteristics, completion techniques, frac stages, and proppant volumes. Eleven of the wells utilized 40/80 mesh LWC proppant while five wells utilized 40/70 mesh CRCS. The average five month cumulative gas production for the CRCS wells was 28% higher than the LWC wells. Production was normalized by pounds of proppant pumped which showed the CRCS wells had 15% more production. See **Fig. 18.**

Fig. 19 shows a boxplot of a five month average cumulative production per pound of proppant for CRCS and LWC wells. The boxplot also illustrates the variation in well production per proppant type. Each box illustrates the data range per quartile. The CRCS wells showed more consistent production versus the LWC wells during the five month study.

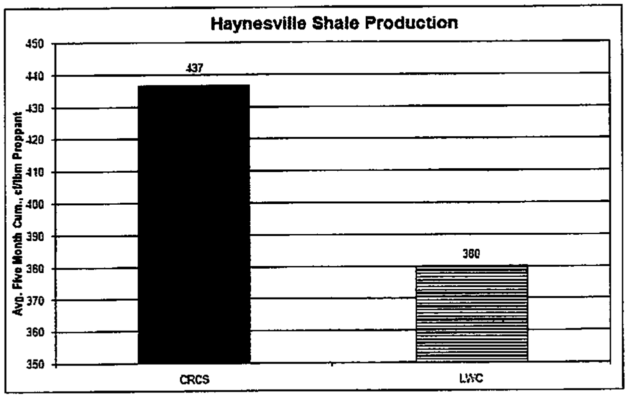

Figure 18—Haynesville Shale five month production comparison of 40/70 CRCS and 40/80 LWC.

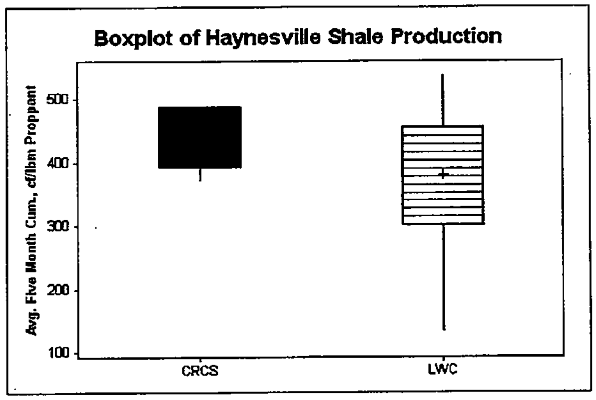

Figure 19—Haynesville Shale five month production comparison of 40/70 CRCS and 40/80 LWC.

Proppant Pack Cyclic Stress Resistance

The amount of proppant fines generated after cyclic stress was measured for CRCS, LWC, and UFS. **Fig. 20** shows the results of these tests, indicating that CRCS has the lowest amount of fines followed by LWC. A sieve analysis was conducted on these fines to determine the particle size distribution. **Fig. 21** shows the percent of fines < 100 mesh. CRCS has no fines < 100 mesh, while UFS has 56.2% fines < 100 mesh and LWC has 71.3% fines < 100 mesh. Proppant fines < 100 mesh are more likely to migrate through the proppant pack, reducing pack permeability compared to larger particles.

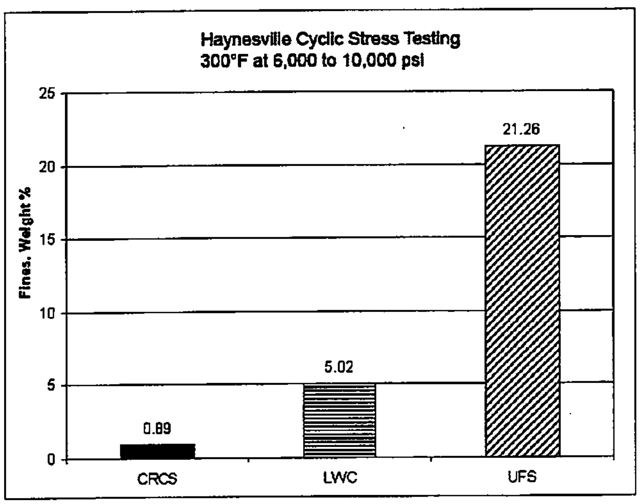

Figure 20—Cyclic stress test results comparison of 40/70 CRCS, 40/80 LWC, and 40/70 UFS.

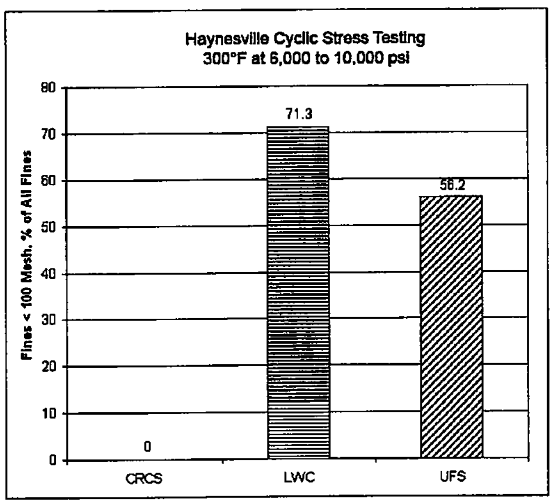

Figure 21—Amount of fines < 100 mesh from cyclic stress test.

Proppant Embedment

During testing, we found that 40/80 LWC proppant embeds 202 microns into the Haynesville core. The published mean diameter of 40/80 LWC is 308 microns. The published propped width of 40/80 LWC at 1 lbm/ft^2 is 3,151 microns. The reduced frac width from 40/80 LWC embedment is 2,747 microns which is a 12.8% reduction.

40/80 LWC has almost two times the embedment depth into Haynesville shale core compared to 40/70 CRCS as shown in **Fig. 22.** We determined the amount of formation fines generated from embedment (as shown in **Fig. 23)** by using the mean particle diameter and embedment depth for each proppant tested. The amount of formation fines from embedment is much more for 40/80 LWC compared to 40/70 CRCS. Photos of Haynesville Shale embedment are shown from a 40/80 LWC **(Fig. 24)** and also 40/70 CRCS and 40/80 LWC **(Fig. 25).**

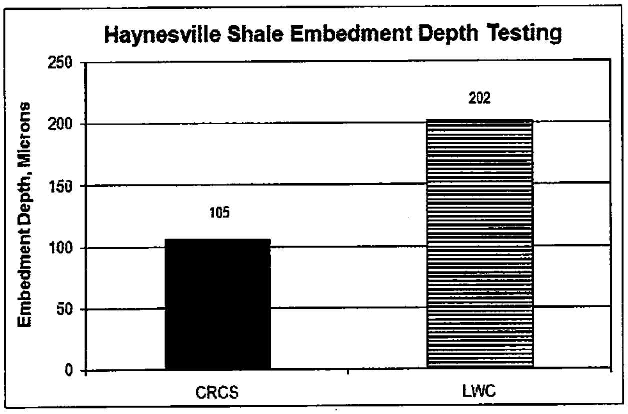

Fig. 22—Haynesville Shale embedment depth with 40/70 CRCS and 40/80 LWC after three days at 300°F and 10,000 psi closure stress.

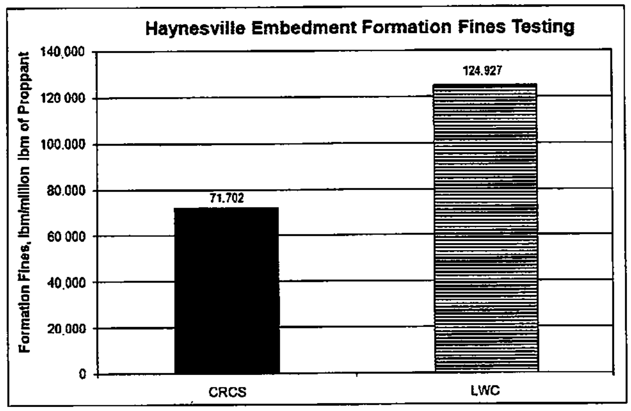

Figure 23—Formation fines generated from Haynesville Shale embedment with 40/70 CRCS and 40/80 LWC after three days at 300°F and 10,000 psi closure stress.

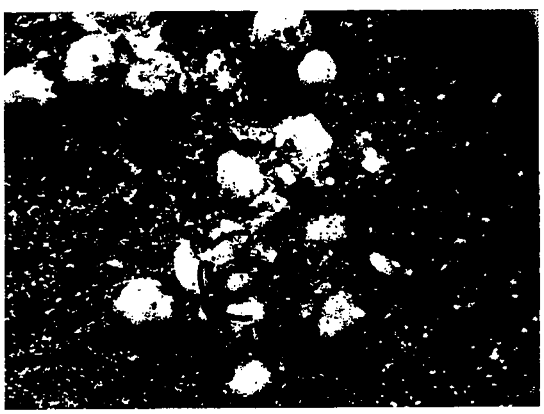

Fig. 24—40/80 LWC embedment into Haynesville core sample. Notice grains (circled) are fully embedded into core.

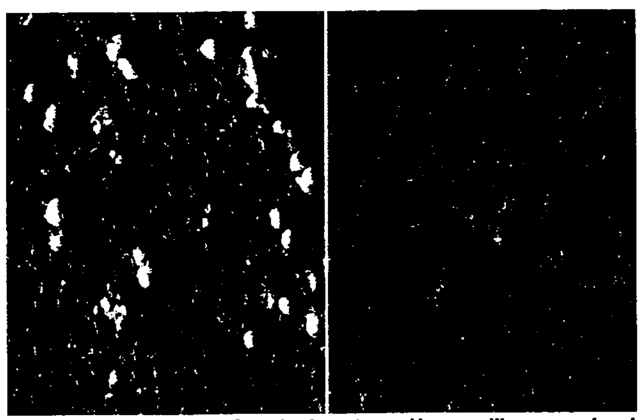

Fig. 25—Comparison of embedment on Haynesville core showing 40/80 LWC (left) and 40/70 CRCS (right).

Fracture Conductivity Correlation

The FCC equation for the Haynesville Shale is:

$$\Delta PI = (\Delta EC / \Phi_5) + PE$$

The five month production increase for the CRCS wells versus the LWC wells is a function of the difference in EC and PE plus other unknown factors (Φ_5) such as proppant flowback, pack rearrangement, and proppant scaling.

$$15\% = (-8\% / \Phi_5) + 17\%$$

$\Phi_5 = 4.0$ for Haynesville Shale FCC. See **Table 3**.

Table 3 FCC for Haynesville Shale

	Proppant Type			
Factor	**UFS**	**CRCS**	**Difference**	**Factor**
Effective Conductivity (EC) – Five month average stress	730 md-ft	669 md-ft	-8%	6,000 psi, LWC = 2.4% fines, CRCS = 0.0% fines
Proppant Embedment (PE) – Frac width at maximum stress	1,172 microns	1,366 microns	17%	Increase in frac width due to less CRCS embedment at 0.5 PPSF, % change is same between 6,000 psi and 10,000 psi
Production Increase (PI)			15%	Five month cumulative average well production difference per lbm of proppant

Procedures

Wet, Hot Crush Test

Fayetteville - Proppant is exposed to 2% KCl water, 200°F and 1,000 psi closure pressure for 24 hours in a crush cell at 2 lbm/ft^2. A standard crush test is then performed following ISO procedures.
Bakken - Proppant is exposed to high temperature oil, 275°F and 1,000 psi closure pressure for 24 hours in a crush cell at 2 lbm/ft^2. A standard crush test is then performed following ISO procedures.
Haynesville - Proppant is exposed to high temperature oil, 300°F and 1,000 psi closure pressure for 24 hours in a crush cell at 2 lbm/ft^2. A standard crush test is then performed following ISO procedures.

Cyclic Stress Test

Proppant is exposed to high temperature oil, temperature and closure pressure to simulate downhole fracture conditions in a crush cell at 2 lbm/ft^2. Three stress cycles are applied to the proppant starting at the high closure pressure. Time at each closure pressure is one hour. The sample is then sieved to quantify the fines generated following ISO procedures.

Embedment Test

Proppant in high temperature oil is placed on a formation core plug at 2 lbm/ft^2 in the bottom of a standard crush cell. Temperature and closure pressure to simulate downhole fracture conditions are applied to the proppant and core for the desired test duration.

Scale Test

Proppant, simulated formation water, and formation particles are placed in a test cell. To simulate downhole fracture conditions, temperature and closure pressure are applied to the proppant and formation particles for 15 days.

Z-Step Measure

We utilized a microscope with a piezo motorized movement. Piezo motorized movement steps are calculated using software to digitally analyze the z-axis and has accuracy within 10 microns. This method was used to examine the depths of embedment of proppant grains into the core face.

Conclusions

1. In the three shale areas studied, Fayetteville, Bakken and Haynesville, curable resin coated sand with grain-to-grain bonding provided higher well production than both uncoated frac sand and lightweight ceramic.

2. Curable resin coated sand had less fines generated compared to uncoated frac sand and lightweight ceramic when tested at realistic downhole fracture conditions with and without cyclic stress.

3. Curable resin coated sand had less embedment in the Bakken and Haynesville cores compared to uncoated frac sand and lightweight ceramic.

4. Curable resin coated sand produced less formation fines due to embedment in both the Bakken and Haynesville compared to uncoated frac sand and lightweight ceramic.

5. Lightweight ceramic formed scale with the Haynesville shale core when tested at downhole conditions. Curable resin coated sand showed no scale formation with the Haynesville core when tested at downhole conditions.

6. A new method of measuring proppant fines generated under downhole pressure, fluid, and temperature was developed.

7. A new method of measuring proppant embedment depth was developed.

8. Effective conductivity was used to include the effect of proppant fines migration on downhole proppant performance.

9. A fracture conductivity correlation was developed between well production and fracture conductivity for the Fayetteville, Bakken, and Haynesville.

Nomenclature

Φ = FCC correction factor
API = American Petroleum Institute
bbl = barrels
bbl/D = barrels per day
bbl/min = barrels per minute
CAT = computerized axial tomography
cf = cubic ft
CRCS = curable resin coated sand
EC = effective conductivity
°F = degrees Fahrenheit
FC = fracture conductivity
FCC = fracture conductivity correlation
FG = fracture gradient
ft = feet
ft^3/D *= cubic ft per day*
HPHT = high pressure, high temperature
IP = initial production
ISO = International Organization for Standardization
KCl = potassium chloride
lbm = pounds mass
lbm/ft^2 *= pounds per cubic ft*
LWC = lightweight ceramic
Mcf = thousand cubic ft
mm = millimeter
MMcf = million cubic ft
PE = proppant embedment
PF = proppant flowback
PPR= proppant pack rearrangement
PRCS = precured resin coated sand
psi = pounds per square inch
PS = proppant scaling
RC = reference conductivity
RCS = resin coated sand
ROI = return on investment
SEM = scanning electron microscope
UCS = unconfined compressive strength

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Conversion Factors

bbl x 1.589873 E-01 = m^3
cu ft x 2.831685 E-02 = m^3
degree C = (°F-32)/1.8
ft x 3.048* E-01 = m
gal x 3.785412 E-03 m^3
in. x 2.54* E+01 = mm
lbm x 4.535924 E-01 = kg
lbm/ft^2 x 4.882428 E+00 kg/m^2
lbm/ft^3 x 1.601846 E+01 kg/m^3
lbm/gal 1.198264 E+02 kg/m^3
psi x 6.894757 E+00 = kPa
sq ft x 9.290304 E+00 = m^2
sq mi x 2.589988 E+00 = km^2

*Conversion factor is exact.

Exhibit 3 to

Declaration of David Gallagher

CARBOHYDROPROP®

Lightweight ceramic proppant for slickwater fracturing

FEATURES

- Ideal for slickwater fracturing applications.
- Best combination of proppant transport and conductivity on the market.

ADVANTAGES

- Superior thermal stability compared to sand or resin-coated sand.
- Priced similarly to resin coated sand for optimum value.
- 40/80 mesh provides similar transport characteristics to 40/70 sands.

BENEFITS

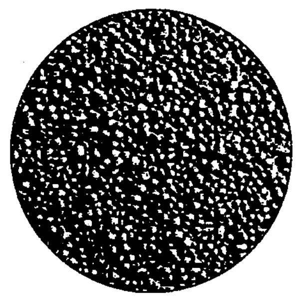
- Greater productivity: 40% more conductivity than higher priced 40/70 premium resin-coated sand.
- Greater productivity: More than twice the conductivity of standard 40/70 resin-coated sand or white sand.

Physical and Chemical Properties

Typical Sieve Analysis [weight % retained]

U.S. Mesh [mesh]	Microns	40/80
+40 mesh	+425	2
-40+50 mesh	-425+300	68
-50+80 mesh	-300+180	30
Median Particle Diameter [microns]		325
API Crush Test		
% by weight fines generated	@5000psi	0.5%
	@7500 psi	2.0%

Sizing Requirements: *A minimum of 90% of the tested sample should fall between the designated sieve sizes. These specifications meet the recommended practices as detailed in ISO 13503-2.*



CARBO*HYDROPROP* 40/80

Typical Additional Properties

Apparent Specific Gravity	2.55
Roundness	0.8
Sphericity	0.9
Bulk Density [lb/ft³]	87
[g/cm³]	1.40
Absolute Volume [gal/lb]	0.047
Solubility in 12/3 HCl/HF Acid [% weight loss]	4.8

CARBO® CERAMICS

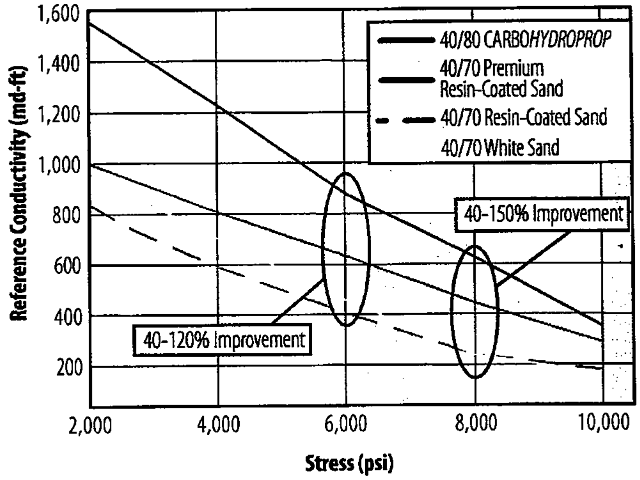
CarboCeramics.com

Long-Term Conductivity

Reference Conductivity* @ 250°F

Closure Stress [psi]	Conductivity [md-ft]	Permeability [Darcies]
2,000	1,570	80
4,000	1,210	62
6,000	890	47
8,000	610	33
10,000	360	21

Reference conductivity comparison between 40/80 CARBO*HYDROPROP* and other products

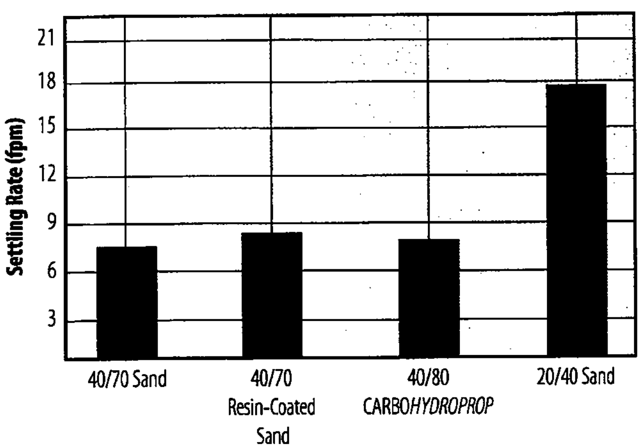


Reference conductivity and permeability are measured with a single phase fluid under laminar flow conditions in accordance with ISO 13503-5. In an actual fracture, the effective conductivity will be much lower due to non-Darcy and multiphase flow effects. For more information, please refer to SPE Paper #106301.

*40/80 **CARBO**HYDROPROP provides significantly higher baseline conductivity than competing sand and resin-coated materials (based on published data). Under realistic conditions, the advantage of stronger, more durable ceramic proppants would be further accentuated (SPE 106301).*

Proppant Transport

Settling Rate in 2% KCl Fluid



*40/80 **CARBO**HYDROPROP provides settling rates similar to 40/70 sand and resin-coated sand.*

40/80 **CARBO***HYDROPROP* capitalizes on the reduced settling rates afforded by small particle diameter, while retaining the benefits of a high quality ceramic proppant. According to Stokes' Law, pellet diameter has a greater impact on transport than particle density. 40/80 **CARBO***HYDROPROP* provides similar settling velocities to 40/70 sand or resin-coated sand, and exhibits uniform, spherical and rigid particles.

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CARBO® CERAMICS

Exhibit 4 to

Declaration of David Gallagher

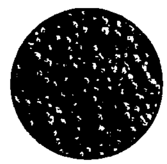
CARBOECONOPROP®

Low-cost lightweight ceramic proppant

FEATURES

- Developed for the largest well population.
- Bulk density and specific gravity similar to frac sand.
- High conductivity, making it more cost-effective than resin-coated sands.
- Chemically inert, will not react with fracturing fluid crosslinkers and breakers.
- Available in two standard sizes — 20/40 and 30/50

Physical and Chemical Properties



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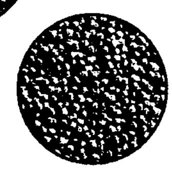


30/50

Typical Sieve Analysis [weight % retained]

U.S. Mesh [mesh]	Microns	20/40	30/50
-16+20 mesh	-1180+850	5	—
-20+30 mesh	-850+600	60	3
-30+40 mesh	-600+425	35	79
-40+50 mesh	-425+300	—	17
-40+60 mesh	-425+250	—	—
-50 mesh	-300	—	1
Median Particle Diameter [microns]		635	473
API Crush Test			
% by weight fines generated	@5,000psi	1.0	0.8
	@7,500 psi	5.2	2.8

Sizing Requirements: *A minimum of 90% of the tested sample should fall between the designated sieve sizes. These specifications meet the recommended practices as detailed in ISO 13503-2.*

Typical Additional Properties

Roundness	0.9	Chemistry [weight %]	
Sphericity	0.9	Al_2O_3	48
Bulk Density [lb/ft³]	96	SiO_2	48
[g/cm³]	1.56	TiO_2	2
Apparent Specific Gravity	2.70	Fe_2O_3	1
Absolute Volume [gal/lb]	0.044	Other	1
Solubility in 12/3 HCl/HF Acid [% weight loss]	1.7		

CARBO® CERAMICS

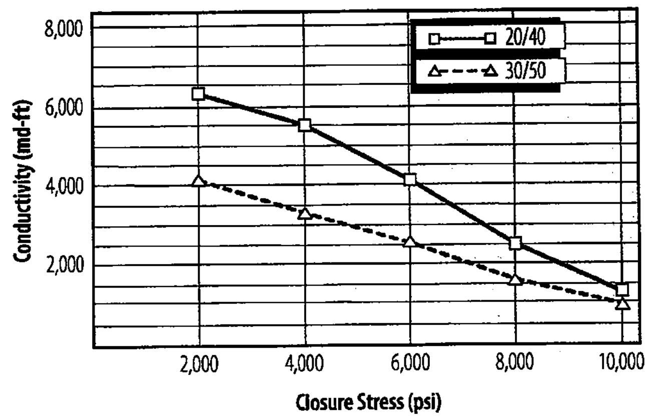
CarboCeramics.com

Long-Term Conductivity

Reference Conductivity*, md-ft @ 250˚F

Closure Stress [psi]	2 lb/ft² 20/40	2 lb/ft² 30/50
2,000	6,300	4,150
4,000	5,500	3,300
6,000	4,100	2,550
8,000	2,500	1,600
10,000	1,300	975

2 lb/ft², 250°F, with 2% KCl | Between Ohio sandstone



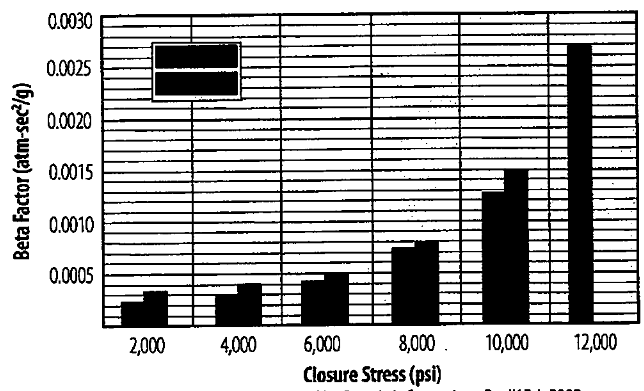
Reference Permeability, Darcies @ 250˚F

Closure Stress [psi]	2 lb/ft² 20/40	2 lb/ft² 30/50
2,000	340	220
4,000	300	180
6,000	230	140
8,000	150	90
10,000	85	65

Beta Factors

Closure Stress [psi]	Beta Factor [atm sec²/g] 20/40	30/50
2,000	0.00024	0.00035
4,000	0.00029	0.00040
6,000	0.00043	0.00050
8,000	0.00075	0.00080
10,000	0.00129	0.00150
12,000	0.00268	—

2 lb/ft², 250°F, with 2% KCl | Between Ohio sandstone,
Young's modulus of 5x10⁶ psi | No gel damage included



Beta Factor data reported by Stim-Lab Consortium, PredK Feb 2002

** Reference conductivity and permeability are measured with a single phase fluid under laminar flow conditions in accordance with ISO 13503-5. In an actual fracture, the effective conductivity will be much lower due to non-Darcy and multiphase flow effects. For more information, please refer to SPE Paper #106301.*

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CARBO® CERAMICS

Exhibit 5 to

Declaration of David Gallagher

CARBOLITE®

Lightweight, high-performance proppant

FEATURES

- The ideal high-performance proppant in oil wells.
- High flow capacity for enhanced production rates.
- Provides highest fracture conductivity in wells to moderate depths.
- Bulk density and specific gravity similar to sand.
- Available in five closely sieved standard sizes - 12/18, 16/20, 20/40, 30/50 and 40/70.

Physical and Chemical Properties

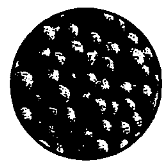
Typical Sieve Analysis [weight % retained]

U.S. Mesh [mesh]	Microns	12/18	16/20	20/40	30/50	40/70
+12 mesh	+1700	4	—	—	—	—
-12+16 mesh	-1700+1180	91	5	—	—	—
-16+20 mesh	-1180+850	5	93	7	—	—
-20+30 mesh	-850+600	—	2	90	4	—
-30+40 mesh	-600+425	—	—	3	90	1
-40 mesh	-425	—	—	—	6	—
-40+60 mesh	-425+250	—	—	—	—	97
-50 mesh	-300	—	—	—	—	—
-60+70 mesh	-250+212	—	—	—	—	2
Median Particle Diameter [microns]		1374	1001	730	522	334
API Crush Test % by weight fines generated	@7,500 psi	17.9	14.0	5.2	2.5	2.0
	@10,000 psi	—	19.3	8.3	5.8	4.4

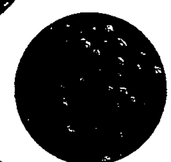
Sizing Requirements: *A minimum of 90% of the tested sample should fall between the designated sieve sizes. These specifications meet the recommended practices as detailed in ISO 13503-2.*

Typical Additional Properties

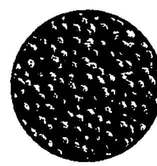
Roundness	0.9	Chemistry [weight %]	
Sphericity	0.9	Al_2O_3	51
Bulk Density [lb/ft³]	97	SiO_2	45
[g/cm³]	1.57	TiO_2	2
Apparent Specific Gravity	2.71	Fe_2O_3	1
Absolute Volume [gal/lb]	0.044	Other	1
Solubility in 12/3 HCl/HF Acid [% weight loss]	1.7		



12/18



16/20



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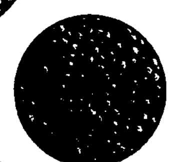

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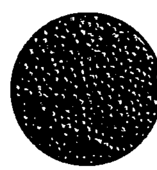


40/70

CARBO® CERAMICS

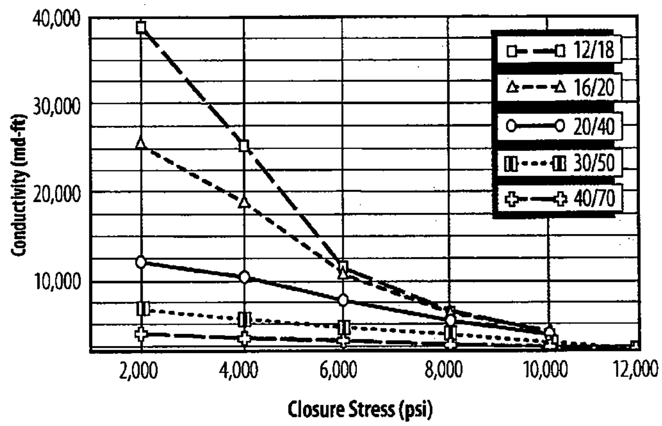
CarboCeramics.com

Long-Term Conductivity

Reference Conductivity*, md-ft @ 250°F

Closure Stress [psi]	2 lb/ft² 12/18	2 lb/ft² 16/20	2 lb/ft² 20/40	2 lb/ft² 30/50	2 lb/ft² 40/70
2,000	38,795	24,629	10,700	4,640	2,200
4,000	24,558	17,781	8,900	3,740	1,660
6,000	9,941	9,035	6,000	2,870	1,270
8,000	4,839	4,623	3,700	1,900	870
10,000	2,234	2,398	2,000	1,270	555
12,000	—	—	—	650	340

2 lb/ft², 250°F, with 2% KCl | Between Ohio sandstone



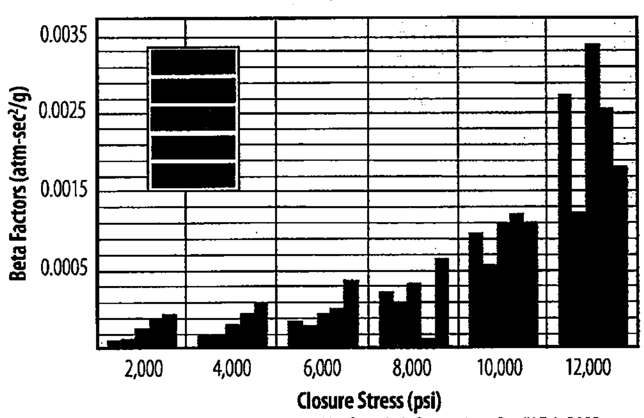
Reference Permeability, Darcies @ 250°F

Closure Stress [psi]	2 lb/ft² 12/18	2 lb/ft² 16/20	2 lb/ft² 20/40	2 lb/ft² 30/50	2 lb/ft² 40/70
2,000	2,003	1,288	570	250	135
4,000	1,325	955	480	200	100
6,000	570	510	340	160	80
8,000	293	276	210	110	60
10,000	141	150	120	75	35
12,000	—	—	—	40	25

Beta Factors

Closure Stress [psi]	Beta Factor [atm sec²/g] 12/18	16/20	20/40	30/50	40/70
2,000	0.00007	0.00009	0.00020	0.00030	0.00034
4,000	0.00011	0.00011	0.00024	0.00035	0.00046
6,000	0.00027	0.00022	0.00035	0.00040	0.00070
8,000	0.00058	0.00045	0.00066	0.00080	0.00092
10,000	0.00120	0.00086	0.00131	0.00140	0.00131
12,000	0.00266	0.00141	0.00319	0.00250	0.00190

2 lb/ft², 250°F, with 2% KCl | Between Ohio sandstone,
Young's modulus of $5x10^6$ psi | No gel damage included



Beta Factor data reported by Stim-Lab Consortium, PredK Feb 2002

** Reference conductivity and permeability are measured with a single phase fluid under laminar flow conditions in accordance with ISO 13503-5. In an actual fracture, the effective conductivity will be much lower due to non-Darcy and multiphase flow effects. For more information, please refer to SPE Paper #106301.*

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CARBO® CERAMICS

Exhibit 6 to

Declaration of David Gallagher

Table of Contents

UNITED STATES SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

Form 10-K

☑ **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(D) OF THE SECURITIES EXCHANGE ACT OF 1934**
For the fiscal year ended December 31, 2010

or

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(D) OF THE SECURITIES EXCHANGE ACT OF 1934**
For the transition period from to

Commission File No. 001-15903

CARBO Ceramics Inc.
(Exact name of registrant as specified in its charter)

DELAWARE	72-1100013
(State or other jurisdiction of incorporation or organization)	*(I.R.S. Employer Identification Number)*

575 North Dairy Ashford
Suite 300
Houston, Texas 77079
(Address of principal executive offices)
(281) 921-6400
(Registrant's telephone number)

Securities registered pursuant to Section 12(b) of the Act:

Title of Each Class	Name of Each Exchange on Which Registered
Common Stock, par value $0.01 per share	New York Stock Exchange
Preferred Stock Purchase Rights	New York Stock Exchange

Securities registered pursuant to Section 12(g) of the Act:
None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☑ No ☐

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes ☐ No ☑

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☑ No ☐

Indicate by check mark whether the registrant has submitted electronically and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted pursuant to Rule 405 of Regulation S-T (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit and post such files). Yes ☑ No ☐

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K is not contained herein, and will not be contained, to the best of registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. ☑

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, or a smaller reporting company. See the definitions of "large accelerated filer," "accelerated filer" and "smaller reporting company" in Rule 12b-2 of the Exchange Act. (Check one):

Large accelerated filer ☑ Accelerated filer ☐ Non-accelerated filer ☐ Smaller reporting company ☐
(Do not check if a smaller reporting company)

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Act). Yes ☐ No ☑

The aggregate market value of the Common Stock held by non-affiliates of the Registrant, based upon the closing sale price of the Common Stock on June 30, 2010, as reported on the New York Stock Exchange, was approximately $1,156,181,491. Shares of Common Stock held by each executive officer and director and by each person who owns

10% or more of the outstanding Common Stock have been excluded in that such persons may be deemed to be affiliates. This determination of affiliate status is not necessarily a conclusive determination for other purposes.

As of February 22, 2011, the Registrant had 23,159,918 shares of Common Stock outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the Proxy Statement for Registrant's Annual Meeting of Stockholders to be held May 17, 2011, are incorporated by reference in Part III.

PART I

Item 1. *Business*

General

CARBO Ceramics Inc. (the "Company") is the world's largest supplier of ceramic proppant, the provider of the industry's most popular fracture simulation software, and provides fracture design and consulting services. The Company also provides a broad range of technologies for spill prevention, containment and geotechnical monitoring. On October 10, 2008, the Company completed the sale of its fracture and reservoir diagnostics business. Because of the transaction, the results of this business have been accounted for as discontinued operations. Continuing operations include the Company's ceramic proppant, software, consulting services, spill prevention and containment and geotechnical monitoring businesses. The Company sells the majority of its products and services to operators of oil and natural gas wells and to oilfield service companies to help increase the production rates and the amount of oil and natural gas ultimately recoverable from these wells. The Company's products and services are primarily used in the hydraulic fracturing of natural gas and oil wells. The Company was incorporated in 1987 in Delaware. As used herein, "Company", "we", "our" and "us" may refer to the Company and/or its consolidated subsidiaries.

Hydraulic fracturing is the most widely used method of increasing production from oil and natural gas wells. The hydraulic fracturing process consists of pumping fluids down a natural gas or oil well at pressures sufficient to create fractures in the hydrocarbon-bearing rock formation. A granular material, called proppant, is suspended and transported in the fluid and fills the fracture, "propping" it open once high-pressure pumping stops. The proppant-filled fracture creates a conductive channel through which the hydrocarbons can flow more freely from the formation to the well and then to the surface.

There are three primary types of proppant that can be utilized in the hydraulic fracturing process: sand, resin-coated sand and ceramic. Sand is the least expensive proppant, resin-coated sand is more expensive and ceramic proppant is typically the most expensive. The higher initial cost of ceramic proppant is justified by the fact that the use of these proppants in certain well conditions results in an increase in the production rate of oil and natural gas, an increase in the total oil or natural gas that can be recovered from the well and, consequently, an increase in cash flow for the operators of the well. The increased production rates are primarily attributable to the higher strength and more uniform size and shape of ceramic proppant versus alternative materials.

The Company primarily manufactures five distinct ceramic proppants. CARBO *HSP* ® and CARBO *PROP* ® are high strength proppants designed primarily for use in deep oil and gas wells. CARBO *HSP* ® has the highest strength of any of the ceramic proppants manufactured by the Company and is used primarily in the fracturing of deep oil and gas wells. CARBO *PROP* ® is slightly lower in weight and strength than CARBO *HSP* ® and was developed for use in deep oil and gas wells that do not require the strength of CARBO *HSP* ®.

CARBO *LITE* ®, CARBO *ECONOPROP* ® and CARBO *HYDROPROP* ® are lightweight ceramic proppants. CARBO *LITE* ® is used in medium depth oil and gas wells, where the additional strength of ceramic proppant may not be essential, but where higher production rates can be achieved due to the product's uniform size and spherical shape. CARBO *ECONOPROP* ® was introduced to compete directly with sand-based proppant, and CARBO *HYDROPROP* ® was introduced in late 2007 to improve performance in "slickwater" fracture treatments.

During 2010, the Company began production of resin coated ceramic (CARBO *BOND* ® LITE) and resin coated sand (CARBO *BOND* ® *RCS*) proppants. The introduction of CARBO *BOND* ® LITE addresses a niche market in which oil and natural gas wells are subject to the risk of proppant flow-back. In the case of CARBO *BOND* ® *RCS*, the Company made the strategic decision to offer a lower cost, lower conductivity alternative proppant, in addition to its ceramic proppant products thereby broadening its proppant suite of products.

During the year ended December 31, 2010, the Company generated approximately 77% of its revenues in the United States and 23% in international markets.

The Company also sells fracture simulation software and provides fracture design, engineering and consulting services to oil and natural gas companies worldwide through its wholly-owned subsidiary, StrataGen, Inc. The

Company provides a suite of stimulation software to the industry that have marked capabilities for on-site real-time analysis. This has enabled recognition and remediation of potential stimulation problems. This stimulation software is tightly integrated with reservoir simulators, thus allowing for stimulation treatment and production optimization. The Company's specialized engineering team consults and works with operators around the world to help optimize well placement, fracture treatment design and production stimulation. The broad range of expertise of the Company's consultants includes: fracture treatment design; completion engineering support; on-site treatment supervision, engineering and quality control; post-treatment evaluation and optimization; reservoir and fracture engineering studies; rock mechanics and software application and training.

Demand for most of the Company's products and services depends primarily upon the demand for natural gas and oil and on the number of natural gas and oil wells drilled, completed or re-completed worldwide. More specifically, the demand for the Company's products and services is dependent on the number of oil and natural gas wells that are hydraulically fractured to stimulate production.

The Company also provides a broad range of technologies and products for geotechnical monitoring through its wholly owned subsidiary Applied Geomechanics, Inc. ("AGI"). AGI provides monitoring systems and services for bridges, buildings, tunnels, dams, slopes, embankments, volcanoes, landslides, mines and construction projects around the world. It serves a wide spectrum of customers in markets ranging from auto racing teams to surveyors, experimental physicists, radio astronomers and naval architects.

In October 2009, Falcon Technologies and Services, Inc. ("Falcon Technologies"), a wholly-owned subsidiary of the Company, purchased substantially all of the assets of BBL Falcon Industries, Ltd., a supplier of spill prevention, containment and countermeasure systems for the oil and gas industry. The acquisition broadened the Company's product and service offerings to its existing client base. Falcon Technologies uses proprietary technology to provide products that are designed to enable its clients to extend the life of their storage assets, reduce the potential for hydrocarbon spills and provide containment of stored materials.

Competition

One of the Company's largest worldwide proppant competitors is Saint-Gobain Proppants ("Saint-Gobain"). Saint-Gobain is a division of Compagnie de Saint-Gobain, a large French glass and materials company. Saint-Gobain manufactures a variety of ceramic proppants that it markets in competition with each of the Company's products. Saint-Gobain's primary manufacturing facility is located in Fort Smith, Arkansas. Saint-Gobain also manufactures ceramic proppant in China and Venezuela. Mineracao Curimbaba ("Curimbaba"), based in Brazil, is also a large competitor and manufactures ceramic proppants that it markets in competition with some of the Company's products.

There are two major manufacturers of ceramic proppant in Russia. Borovichi Refractory Plant ("Borovichi") located in Borovichi, Russia, and FORES Refractory Plant ("FORES") located in Ekaterinburg, Russia. Although the Company has limited information about Borovichi and FORES, the Company believes that Borovichi primarily manufactures intermediate strength ceramic proppants and markets its products principally within Russia, and that FORES manufactures intermediate strength and lightweight ceramic proppant lines and markets its products both in and outside of Russia. The Company further believes that these companies have added manufacturing capacity in recent years and now provide a majority of the ceramic proppant used in Russia. The Company is also aware of an increasing number of manufacturers in China. Most of these companies produce intermediate strength ceramic proppants that are marketed both in and outside of China.

Competition for CARBO *HSP* ® and CARBO *PROP* ® principally includes ceramic proppant manufactured by Saint-Gobain and Curimbaba. The Company's CARBO *LITE* ®, CARBO *ECONOPROP* ® and CARBO *HYDROPROP* ® products compete primarily with ceramic proppant produced by Saint-Gobain and Curimbaba and with sand-based proppant for use in the hydraulic fracturing of medium depth natural gas and oil wells. The leading suppliers of mined sand are Unimin Corp., Badger Mining Corp., Fairmount Minerals Limited, Inc., and Ogelbay-Norton Company. The leading suppliers of resin-coated sand are Hexion Specialty Chemicals, Inc. and Santrol, a subsidiary of Fairmount Minerals.

The Company believes that the most significant factors that influence a customer's decision to purchase the Company's ceramic proppant are (i) price/performance ratio, (ii) on-time delivery performance, (iii) technical support and (iv) proppant availability. The Company believes that its products are competitively priced and that its delivery performance is excellent. The Company also believes that its superior technical support has enabled it to persuade customers to use ceramic proppant in an increasingly broad range of applications and thus increased the overall market for the Company's products. Since 1993, the Company has consistently expanded its manufacturing capacity and plans to continue its strategy of adding capacity, as needed, to meet anticipated future increases in sales demand.

The Company continually conducts testing and development activities with respect to alternative raw materials to be used in the Company's existing and alternative production methods. For information regarding the Company's research and development expenditures see Note 1 to the "Notes to Consolidated Financial Statements." The Company is actively involved in the development of alternative products for use as proppant in the hydraulic fracturing process and is aware of others engaged in similar development activities. The Company believes that while there are potential specialty applications for these products, they will not significantly impact the use of ceramic proppants. The Company believes that the "know-how" and trade secrets necessary to efficiently manufacture a product of consistently high quality are difficult barriers to entry to overcome.

Customers and Marketing

The Company's largest customers are participants in the petroleum pressure pumping industry. Specifically, Halliburton Energy Services, Inc. and Schlumberger Limited each accounted for more than 10% of the Company's 2010 and 2009 revenues. However, the end users of the Company's products are the operators of natural gas and oil wells that hire the pressure pumping service companies to hydraulically fracture wells. The Company works both with the pressure pumping service companies and directly with the operators of natural gas and oil wells to present the technical and economic advantages of using ceramic proppant. The Company generally supplies its customers with products on a just-in-time basis, as specified in individual purchase orders. Continuing sales of product depend on the Company's direct customers and the well operators being satisfied with product quality, availability and delivery performance. The Company provides its software simulation products and consulting services directly to owners and/or operators of oil and gas wells.

The Company recognizes the importance of a technical marketing program in demonstrating long-term economic advantages when selling products and services that offer financial benefits over time. The Company has a broad technical sales force to advise end users on the benefits of using ceramic proppant and performing fracture simulation and consultation services.

Although the Company's initial products were originally intended for use in deep wells that require high-strength proppant, the Company believes that there is economic benefit to well operators of using ceramic proppant in shallower wells that do not necessarily require a high-strength proppant. The Company believes that its new product introductions and education-based technical marketing efforts have allowed it to capture a greater portion of the market for sand-based proppant in recent years and will continue to do so in the future.

The Company provides a variety of technical support services and has developed computer software that models the return on investment achievable by using the Company's ceramic proppant versus alternatives in the hydraulic fracturing of a natural gas or oil well. In addition to the increased technical marketing effort, the Company from time to time engages in field trials to demonstrate the economic benefits of its products and validate the findings of its computer simulations. Periodically, the Company provides proppant to production companies for field trials, on a discounted basis, in exchange for a production company's agreement to provide production data for direct comparison of the results of fracturing with ceramic proppant as compared to alternative proppants.

The Company's international marketing efforts are conducted primarily through its sales offices in Dubai, United Arab Emirates; Aberdeen, Scotland; Beijing, China; and Moscow, Russia, and through commissioned sales agents located in South America and China. The Company's products and services are used worldwide by U.S. customers operating domestically and abroad, and by foreign customers. Sales outside the United States accounted for 23%, 24% and 29% of the Company's sales for 2010, 2009 and 2008, respectively. The decrease in the proportion of international sales is primarily attributable to increased demand in the U.S. as well as expanded

Exhibit 7 to

Declaration of David Gallagher

SANTROL

About Us | **Products** | Geographic Reach | Contact Us

Download a PDF of the Santrol Proppants North American Product Reference Guide.

Products:
Hard-working proppants for every need

Santrol Proppants produces and delivers high-quality proppants at every level of conductivity for every depth of exploration, deep or shallow—so that every well surrenders all the gas and oil it has to offer for a resource-hungry world. At each level of conductivity, Santrol Proppants supports a variety of wells with an equally broad range of choices, including:

Pre-cured resin coated proppants

- Lightweight ceramic alternatives up to 14,000 psi
- A range of coated proppants up to 10,000 psi
- Base substrate of pure Northern White frac sand

Northern White frac sand

- Premium Northern White sands from the Saint Peter's formation
- 99.8% pure, round, single crystalline, high strength quartz
- Excellent crush resistance @ 4,000 psi

Lake sand

- High purity (93.2%), sub-round quartz sand
- Very good crush resistance @ 4,000 psi

Curable resin coated proppants

- Encapsulated coated lightweight ceramic alternative up to 14,000 psi
- Encapsulated coated proppants up to 10,000 psi
- Base substrate of pure Northern White frac sand
- Activators available for low temperature use with water- or oil-based fracturing fluids

BioBalls - Soluble Perforation Ball Sealers

- Superior alternative to conventional ball sealers
- Soluble, non-distorting perforation ball sealers for slick water and other fracturing methods
- Variety of temperature and time dependent solubility rates for most any application
- Specific gravities from 0.84 to 1.20 provide an excellent application range
- Can withstand perforation differential pressures of up to 8000 psi (@200° F, one hour exposure)
- Environmentally safe and biodegradable

Exhibit 8 to

Declaration of David Gallagher

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UNITED STATES SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

FORM 10-Q

☑ **QUARTERLY REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the quarterly period ended September 30, 2008

or

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the transition period from __________ to __________.

Commission File No. 001-15903

CARBO CERAMICS INC.
(Exact name of registrant as specified in its charter)

DELAWARE State or other jurisdiction of incorporation or organization)	**72-1100013** (I.R.S. Employer Identification Number)

6565 MacArthur Boulevard
Suite 1050
Irving, Texas 75039
(Address of principal executive offices)

(972) 401-0090
(Registrant's telephone number)

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☑ No ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, or a smaller reporting company. See the definitions of "large accelerated filer," "accelerated filer" and "smaller reporting company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer: ☑ Accelerated filer: ☐ Non-accelerated filer: ☐ (Do not check if a smaller reporting company) Smaller reporting company: ☐

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). Yes ☐ No ☑

As of November 5, 2008, 24,456,862 shares of the registrant's Common Stock, par value $.01 per share, were outstanding.

PROPPANT SUPPLY AGREEMENT

THIS PROPPANT SUPPLY AGREEMENT (this "Agreement") is entered into as of August 28, 2008 by and between CARBO Ceramics Inc., a corporation organized under the laws of the state of Delaware and having its principal office at 6565 N. MacArthur Blvd., Suite 1050, Irving, Texas 75039 ("Seller"), and Halliburton Energy Services, Inc., a corporation organized under the laws of the state of Delaware, having its principal office at 10200 Bellaire Blvd., Houston, Texas 77072 ("Buyer"). Buyer and Seller shall each be referred to herein as a "Party." Buyer and Seller shall collectively be referred to herein as the "Parties."

RECITALS

WHEREAS, Seller wishes to achieve operational efficiencies and increase its sales volume of Products (defined below);

WHEREAS, Buyer wishes to enter into this Agreement in order to purchase additional Products from Seller;

WHEREAS, contemporaneously with executing this Agreement, the Parties and Pinnacle Technologies, Inc., a wholly-owned subsidiary of Seller, are also entering into that certain Asset Purchase Agreement ("APA"), dated August 28, 2008; and

WHEREAS, Buyer and Seller wish to establish their rights and obligations with respect to the purchase and sale of the Products as further set forth herein;

NOW, THEREFORE, in consideration of the mutual covenants and agreements herein contained, and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties hereby agree as follows:

AGREEMENT

ARTICLE I- DEFINITIONS

As used herein, the following terms shall have the meanings set forth below. Additional terms are defined throughout the text of this Agreement.

"Actual Purchase Percentage" means the result of the formula set forth in Section 4.1 hereof, which shall be used to determine whether the Purchase Commitment has been met in a Measurement Period.

"Affiliate" means with respect to a specified person, a person that directly, or indirectly through one or more intermediaries, controls or is controlled by, or is under common control with, the person specified. In order for a person or entity to qualify as an Affiliate of Seller, such person or entity must also be primarily and directly engaged in the business of manufacturing and selling Products. No person or entity shall be considered to be directly and primarily engaged in such business solely by means of (i) their ownership of equity interests in Seller or its Affiliates,

(ii) service on the Board of Directors or similar governing body of Seller or its Affiliates or (iii) service as an executive officer of Seller or its Affiliates.

" Base Selling Price " means with respect to each Seller Product Line sold in a Geographic Region, the [***] for sales of such Seller Product Line to customers, other than [***]. An example of the calculation of Base Selling Price is set forth on Exhibit E . [***].

" Buyer Beneficiary " means each of the Affiliates of Buyer that have executed, in conjunction with Seller or its Affiliates, the Affiliate Addendum, the form of which is attached hereto as Exhibit A.

" CARBO Products " means Products produced by Seller, its Affiliates and any of its production subcontractors.

" CARBO Sources " means Seller, its Affiliates and its network of approved, independent distributors as set forth on Exhibit C attached hereto, as the same may be amended by Seller from time to time.

" Effective Date " means the Closing Date, as defined in the APA.

" Geographic Region " means each of the geographic regions as more specifically defined on Exhibit D attached hereto, as each of such regions is applied and defined in the ordinary course of Seller's business.

" Material Breach " means a failure by a Party to perform any material obligation, covenant or undertaking of that Party hereunder, which obligation, covenant or undertaking, if not cured in accordance with the provisions of this Agreement, would deprive the counterparty of a material benefit justifiably expected by the counterparty under this Agreement.

" Measurement Period " shall have the meaning set forth in Section 4.1 hereof.

" 2008 Measurement Period " shall have the meaning set forth in Section 3.3(a) hereof.

" Prioritize " means that in the event of applicable Seller Product shortages, Seller shall use commercially reasonable efforts to fill the orders of Buyer and the Buyer Beneficiaries before orders from other parties for the identical Product made under similar circumstances, including the Geographic Region for which the order is placed.

" Products " means all types and forms of ceramic proppants, including resin-coated ceramic proppants.

" Qualified Purchases " means with respect to each Measurement Period or other applicable period, (i) the number of pounds of CARBO Products purchased worldwide from CARBO Sources by Buyer and the Buyer Beneficiaries plus (ii) the number of pounds of CARBO Products (if any) that are purchased directly from CARBO Sources by customers of Buyer or the Buyer Beneficiaries, and then utilized in a hydraulic fracture treatment job performed by Buyer or Buyer Beneficiaries plus "Unfulfilled Orders"; in each case, during such Measurement Period and less any returns of CARBO Products that are properly authorized and accepted by CARBO Sources. All references to Buyer in this Agreement when addressing Product purchases shall include Product purchases made by Buyer Beneficiaries.

" Seller Product Lines " means each of the Product lines of Seller set forth on Exhibit E attached hereto. Additional Product lines may be added to such Exhibit E by Seller from time to time.

" Threshold Purchases " means with respect to each Measurement Period, the amount of Qualified Purchases that would result in the Actual Purchase Percentage being [***]%.

" Total CARBO Production " means the total number of pounds of CARBO Products produced in a given calendar year.

" Total HP Production " means the total number of pounds of CARBO *HYDROPROP*™ produced by Seller, its Affiliates and any of its production subcontractors in a given calendar year.

" Total Worldwide Purchases " means with respect to each Measurement Period or other applicable period, the total number of pounds of Product purchased worldwide by Buyer and its Affiliates during such time period, regardless of source, less any returns of Products that are properly authorized and accepted by the applicable selling party.

" Unfulfilled Orders " means the total number of pounds of Product (i) actually ordered and not cancelled or withdrawn by Buyer or the Buyer Beneficiaries from Seller or its Affiliates in a given period pursuant to the terms of this Agreement, (ii) which was included in the applicable demand forecast for such period pursuant to Section 2.3 herein, and (iii) which was not delivered by or on behalf of Seller or its Affiliates.

ARTICLE II - AGREEMENT TO PURCHASE AND SELL; FORECASTS

2.1 Agreement to Purchase Products . Except as set forth in the last sentence of Section 4.3 , beginning on the Effective Date and throughout the term of this Agreement, Buyer hereby agrees that it and its Affiliates shall purchase at least [***]% of their total global Product requirements from Seller each calendar year, as further described herein (the " Purchase Commitment "). Notwithstanding the foregoing, in no event shall Buyer or its Affiliates be prohibited from purchasing products on the market from third parties which are similar to the Products, even if such third party is a competitor of Seller. Each Buyer Beneficiary shall execute an Affiliate Addendum before being able to purchase CARBO Products under the terms of this Agreement, using the form set forth herein as Exhibit A . Each Affiliate Addendum shall (a) incorporate the terms of this Agreement, and (b) contain such other provisions as may be reasonably necessary to comply with the applicable laws and regulations of the jurisdiction in which the Buyer Beneficiary is located.

2.2 Agreement to Sell Products . Beginning on the Effective Date and throughout the term of this Agreement, Seller hereby agrees to Prioritize Buyer and Buyer Beneficiaries' CARBO

Product needs pursuant to the terms hereof. All purchases of Products shall be governed by the terms and conditions set forth in this Agreement and in Seller's Terms and Conditions of Sale (" Seller's Terms "), a copy of which is attached hereto as Exhibit B . In the event of a conflict or inconsistency between the terms and conditions set forth herein and Seller's Terms, the terms and conditions of this Agreement shall prevail.

2.3 Forecast for Buyer Demand . No later than 30 calendar days prior to the beginning of each calendar quarter during the term of this Agreement (and upon the Effective Date), Buyer shall provide a reasonably detailed, non-binding forecast prepared in good faith that sets forth the total quantity of each type of Seller's Products that Buyer and the Buyer Beneficiaries reasonably anticipate to purchase from Seller and its Affiliates during such calendar quarter in each Geographic Region (each, a " Demand Forecast "). If Seller does not believe it will be able to meet the quantities requested in a Demand Forecast, Seller may respond in writing to Buyer's Demand Forecast within five (5) calendar days and notify Buyer what quantities of Products it expects to be able to fill (each, a " Revised Demand Forecast "). Buyer may revise its Demand Forecast based on Seller's response and shall notify Seller in writing of such revision within five (5) calendar days of receipt of Seller's Revised Demand Forecast. Except as specifically set forth in Section 4.3 below, in the event of conflict between forecasted quantities, Seller's Revised Demand Forecast shall control for purposes of calculating Unfulfilled Orders. The Parties shall use their best efforts to promptly notify the other upon any material change in each Demand Forecast or Revised Demand Forecast.

ARTICLE III - PRICES; PAYMENT

3.1 Selling Price .

(a) Subject to the provisions of Section 6.1 below, Seller shall sell, and shall cause its Affiliates to sell, each CARBO Product to Buyer or the Buyer Beneficiaries, as applicable, at the then current Base Selling Price, less any discount applicable pursuant to this Article III . Base Selling Prices shall be calculated for each Seller Product Line on [***] basis for each Geographic Region. Upon the [***], and thereafter no later than [***] under this Agreement, Seller shall send Buyer a written report that sets forth the Base Selling Price by Seller Product Line in each Geographic Region (a " Pricing Report "). The Base Selling Price in each Pricing Report shall continue to be in effect until the next Pricing Report is sent to Buyer by Seller.

(b) From time to time during the term of this Agreement, Buyer and Seller may also enter into special written pricing arrangements for Seller Product Lines in particular Geographic Regions. Any such arrangements shall be specified in a written document executed by both Parties.

3.2 Applicable Discount . Subject to Section 3.3 below, during the term of this Agreement, Buyer and Buyer Beneficiaries shall be entitled to receive a discount from the Base Selling Price for each Seller Product sold pursuant to this Agreement depending upon the Actual Purchase Percentage achieved during the last-ended Measurement Period as specified in the table below. Any change in discount shall be effective upon the delivery by Buyer of the report specified in Section 4.2 after the end of a Measurement Period; provided , that Seller's observation of a discount shall not preclude Seller from (i) disputing any item in such report or (ii) subsequently recovering the amount of any excess discount that was granted to Buyer or Buyer Beneficiaries due to discrepancies in such report:

Actual Purchase Percentage Achieved	Discount off Base Selling Price
At least [***]% up to [***]%	[***]%
More than [***]% up to [***]%	[***]%
Greater than [***]%	[***]%

3.3 2008 and 2009 Discount Opportunities . Notwithstanding the provisions of Section 3.2 :

(a) Beginning with the first full calendar month after the Effective Date and continuing for the remainder of the 2008 calendar year (" 2008 Measurement Period "), Seller shall sell its Products to Buyer and Buyer Beneficiaries in each Geographic Region at the lower of (i) the price paid for such Product by Buyer as of the Effective Date or (ii) a [***]% discount off of the applicable Base Selling Price.

(b) If Buyer does not attain at least a [***]% Actual Purchase Percentage for the 2008 Measurement Period, Seller shall continue to offer Products to Buyer at a [***]% discount off Base Selling Price during the 2009 calendar year; provided , that during 2009, Buyer and the Buyer Beneficiaries must collectively purchase at least (i) [***] metric tons of Products manufactured by the plant of Seller's Subsidiary in [***] and (ii) [***] metric tons of Products manufactured by the plant of Seller's Subsidiary in [***]. If applicable, Seller shall make such discount available immediately during 2009. If Buyer does not satisfy the [***] and [***] purchase requirements set forth in this subparagraph (b) by the end of 2009, then Buyer shall pay Seller an amount equal to [***]% of all Qualified Purchases (other than those specified in clause (ii) of such definition) made during 2009 no later than February 1, 2010.

3.4 Payment . Unless agreed to otherwise by Seller or specified herein, payment for all sales of Product shall be made thirty (30) days after the date of the applicable invoice, provided, however, Buyer shall have the right to withhold any amounts disputed in good faith until resolved by the parties; provided, further, that in the event of an invoice that contains both disputed and undisputed amounts, the undisputed amounts will be paid promptly. Payment for Product to Seller or its Affiliates shall be made, at the option of Buyer, (i) in the United States, or (ii) in the country from which the Goods were shipped. All payments hereunder shall be made in U.S. dollars or such other currency in which Seller may quote prices for the relevant Seller Product Lines. Any overdue amounts under this Agreement shall bear interest at a rate equal to the lesser of (a) 1.5% per month or (b) the maximum rate permitted by law. Charges for Product ordered by Buyer Beneficiaries will be invoiced to and paid by such Buyer Beneficiaries.

3.5 Audit Rights . When requested reasonably in advance by Buyer, and subject to the execution of a standard form of confidentiality agreement for such engagements, Buyer shall have the right for an independent third party that is reasonably acceptable to Seller (the " Sales Price Auditor ") to inspect, review and audit any and all records of Seller and its Affiliates during normal business hours that are relevant to the calculation of the Base Selling Price. It is understood that the Sales Price Auditor shall be free to share any and all information discovered during such audit with Buyer that relates to the matters set forth herein, but shall in no case disclose (i) the name of particular customers of Seller or its Affiliates or (ii) specific prices paid for Product (other than for purchases from Buyer and Buyer Beneficiaries). Buyer may not audit records pursuant to this Section 3.5 more than once every twelve months.

ARTICLE IV- DETERMINATION OF PURCHASE COMMITMENT; PENALTY

4.1 Purchase Commitment Calculation . The Parties agree that the determination of whether the Purchase Commitment has been met shall be conducted (i) at the end of each calendar year during the term of this Agreement and (ii) within 45 days of the expiration of the term of this Agreement pursuant to Section 7.1, based upon the days in such calendar year in which this Agreement was in effect (each of clause (i) and (ii), a " Measurement Period ") by means of the following equation:

[Qualified Purchases / Total Worldwide Purchases] x 100% = Actual Purchase Percentage.

4.2 Procedure for Calculation; Damages . Within 20 days of the end of each Measurement Period, Buyer shall send Seller a written report that sets forth in reasonable detail Buyer's calculation of (i) Qualified Purchases, (ii) Total Worldwide Purchases, (iii) the Actual Purchase Percentage for such Measurement Period and (iv) any Liquidated Damages due pursuant to Section 4.3 , along with payment thereof. Seller shall then have 30 days to review each such report, during which Seller shall provide written notice to Buyer of any item thereon that is disputed by Seller. All such disputes shall be settled in accordance with Article IX hereof. Acceptance of any Liquidated Damages payment by Seller shall not act as a waiver by Seller of any inaccuracies in the calculation thereof.

4.3 Penalty for Failure to Meet Purchase Commitment . At the end of each Measurement Period in which the Actual Purchase Percentage is less than [***]%, Buyer shall pay Seller as direct and liquidated damages an amount in U.S. dollars determined by the following equation:

[Threshold Purchases- Qualified Purchases] x $[***] = Liquidated Damages.

Notwithstanding the foregoing, (i) for the 2008 Measurement Period, Buyer shall not be in violation of Section 2.1 hereof and no Liquidated Damages shall be payable and (ii) solely for the purpose of calculating whether any liquidated damages are due and payable for the 2009 calendar year Measurement Period, Unfulfilled Orders shall be based upon the Buyer Demand

Forecasts provided during 2009 as opposed to any Revised Demand Forecasts provided by Seller.

4.4 Additional Buyer Covenants

(a) Buyer agrees to provide Seller a written report within 10 days of the end of each month setting forth (1) the amount of Qualified Purchases during such month (including written documentation that evidences any purchases claimed under clause (ii) of such definition) and (2) the amount of Total Worldwide Purchases during such month. The report shall set forth in reasonable detail the basis for the calculations set forth therein. Seller's receipt of such report shall not prejudice any rights or remedies of Seller under this Agreement for any inaccuracies or misstatements therein.

(b) When requested reasonably in advance by Seller, and subject to the execution of a standard form of confidentiality agreement for such engagements, Seller shall have the right for an independent third party that is reasonably acceptable to Buyer (the " Purchase Commitment Auditor ") to inspect, review and audit any and all records of Buyer and its Affiliates during normal business hours that are relevant to the calculation of the Actual Purchase Percentage, Liquidated Damages or other matters associated with this Agreement. It is understood that the Purchase Commitment Auditor shall be free to share any and all information discovered during such audit with Seller that relates to the matters set forth herein, but shall in no case disclose (i) the name of particular customers of Buyer or its Affiliates or (ii) specific prices paid for Product by Buyer, its Affiliates or its customers (other than for purchases from Seller or its Affiliates). Seller may not audit records pursuant to this Section 4.4(b) more than once every twelve months.

ARTICLE V - ORDER PLACEMENT

5.1 Methods . Seller shall acknowledge each purchase order placed by the Buyer which is in material compliance with this Agreement, and once accepted by Seller, Prioritize each such order.

5.2 Acceptance . Seller's acknowledgment of each purchase order shall constitute acceptance thereof, unless otherwise noted in such acknowledgement.

ARTICLE VI- OTHER AGREEMENTS RELATING TO PRODUCTS

6.1 CARBO *HYDROPROP* ™.

(a) Notwithstanding any provision in this Agreement to the contrary, in no event shall CARBO *HYDROPROP* ™ be eligible for any discount until Seller's Base Selling Price for such Seller Product Line in the Geographic Region "USA Core Area 1" is at least $[***] per pound for a period of [***] consecutive months. After such time, the discounts set forth in this Agreement shall apply to purchases of CARBO *HYDROPROP* ™.

(b) If Buyer attains an Actual Purchase Percentage of [***]% or greater for any Measurement Period and the price of CARBO *HYDROPROP* ™ increases from the level last offered to Buyer prior to the Effective Date, then for a period of [***] months from the date that both such conditions are satisfied, Seller shall not increase Buyer's price for CARBO *HYDROPROP* ™ above the rate charged in each Geographic Region immediately prior to the end of such Measurement Period.

(c) To the extent that such quantities are, in Seller's reasonable discretion, needed to satisfy Buyer demand as set forth in the Product forecasts specified in Section 2.3 , beginning with the 2009 calendar year and on an annual basis thereafter during each full year of the term of this Agreement, Seller shall use commercially reasonable efforts to make available to Buyer an amount of CARBO *HYDROPROP* ™ that is equal to the result of the following equation when using data derived from the prior calendar year:

Total HP Production x [Qualified Purchases/Total CARBO Production] = Annual Amount of CARBO *HYDROPROP*™ to be made available for Buyer purchase.

For example, assume for 2008 (i) [***] pounds of Total HP Production, [***] pounds of Qualified Purchases and [***] pounds of Total CARBO Production. The amount of CARBO *HYDROPROP* ™ to be made available to Buyer during 2009 pursuant to the terms of this Section 6.1(c) shall be equal to [***] pounds [[***]].

6.2 Exclusivity for Newly Developed Products .

(a) Beginning after Buyer has achieved an Actual Purchase Percentage in any Measurement Period of at least [***]%, and until the next Measurement Period determination date in which the Actual Purchase Percentage is less than [***]% (the " Exclusivity Period "), Seller shall offer Buyer the exclusive right to market new commercial Products solely developed by Seller (each, a "Qualified New Product") in accordance with the provisions of this Section 6.2.

(b) If Seller desires to introduce a Qualified New Product to the marketplace during an Exclusivity Period, it shall provide written notice of such fact to Buyer. During the 20 day period after Seller's notice is received, Buyer and Seller shall enter into negotiations concerning the terms applicable to the sale of the Qualified New Product, including the purchase price and minimum quantities that Buyer is willing to commit to purchase. If Buyer provides Seller with a binding written purchase commitment for the Qualified New Product that specifies quantities, purchase prices, timing of purchases and other terms that are reasonably acceptable to Seller during such 20 day period, then Seller shall exclusively sell such Qualified New Product to Buyer and Buyer Beneficiaries for a period of [***] months therefrom.

(c) If Buyer does not provide a written purchase commitment to Seller in accordance with the requirements of Section 6.2(b) above, then after the expiration of such 20 day period, Seller shall be free to offer, market and sell the Qualified New Product to third parties, without any obligation of exclusivity hereunder.

6.3 Forward Stocking of Inventory. From time to time during the term of this Agreement, Seller agrees to discuss in good faith all requests made by Buyer for the forward stocking of Product inventory owned by Seller in select international markets; provided, in no event shall Seller be obligated to place forward-stocked inventory in any jurisdiction where such inventory may result in Seller or its Affiliates having a taxable presence that they would not otherwise have. Buyer agrees to cooperate with Seller in (i) ensuring that any forward stocked inventory agreed to by the Parties remains physically separated from property owned by parties other than Seller and properly secured and (ii) taking any other actions that are necessary or advisable to advise third parties that such inventory is owned by Seller, including the filing of financing statements or other public notice actions that may be available under local regulation. Any forward-stocked inventory shall be automatically sold to and purchased by Buyer at the then-applicable prices and other terms specified in this Agreement upon the earlier of (A) the time that is immediately prior to Buyer's sale of such inventory to a third party or (B) 90 days from the arrival of such inventory at the requested forward stocking location.

6.4 Private Labeling Discussions. During the term of this Agreement, Seller agrees to discuss with Buyer in good faith any initiatives that Buyer would like to propose concerning the labeling of Seller's Products with Buyer's name and logo for sale to Buyer's or Buyer Beneficiary customers.

6.5 Technical and Marketing Cooperation. Buyer and Seller agree to work cooperatively to develop technical marketing materials to expand the market for ceramic proppants. Seller will provide personnel with technical sales expertise to Buyer, at no additional cost, to provide technical sales consultation internally to Buyer and externally to Buyer's customers as requested.

ARTICLE VII - TERM

7.1 Term.

(a) This Agreement shall be effective as of the Effective Date and shall remain in effect for a period of five (5) years from the Effective Date.

(b) This Agreement shall terminate upon the termination of the APA prior to the Effective Date in accordance with its terms. Upon any such termination, neither Party shall have any liability or obligation under this Agreement of any kind.

7.2 Termination After Effective Date. After the Effective Date, this Agreement may be terminated:

(a) by a Party upon the failure of the other Party to cure a Material Breach within ninety (90) days after a written notice of such a Material Breach from the first Party (the "Material Breach Notice"). If such a Material Breach is not cured within ninety (90) days after the date of the Material Breach Notice, then the first Party may terminate this Agreement by providing further written notice to the other Party (the "Termination Notice"); provided that the Termination Notice shall be received by the other Party no later than 30 days after the expiry of the 90-day period following the date of the Material Breach Notice; and provided further that the Termination Notice shall specify a termination date no earlier than the business day following receipt by the other Party of the Termination Notice and no later than 30 days after the expiry of the 90-day period following the date of the Material Breach Notice. Nothing in this paragraph (a) shall prohibit a Party from submitting a dispute relating to the termination of this Agreement to binding arbitration pursuant to Section 9.2 of this Agreement and recovering full damages for such termination in accordance with the terms of this Agreement.

(b) by either Party upon the other Party becoming bankrupt, insolvent, or having a receiver, trustee or other similar person appointed under insolvency laws to manage any part of its business or assets.

Nothing in this Section 7.2 shall be deemed to release any Party from any liability for any breach of this Agreement prior to the effective date of termination.

ARTICLE VIII - CONFIDENTIALITY

8.1 General Obligations .

(a) All Confidential Information relating to or obtained from Buyer or Seller shall be held in confidence by the recipient to the same extent and in at least the same manner as the recipient protects its own confidential or proprietary information, but in no event shall the recipient exercise less than reasonable care. Except as otherwise provided in this Article VIII , neither Buyer or Seller shall disclose, publish, release, transfer or otherwise make available Confidential Information of, or obtained from, the other in any form to, or for the use or benefit of, any person or entity without the disclosing party's prior written consent.

(b) Each of Buyer and Seller shall, however, be permitted to disclose relevant aspects of the other's Confidential Information to its officers, directors, attorneys, accountants and senior-level employees that are directly involved with the performance of this Agreement, and to the officers, directors, attorneys, accountants and such senior-level employees of its Affiliates, (to the extent that such disclosure is not otherwise restricted under any contract, license, consent, permit, approval or authorization granted pursuant to applicable law, rule or regulation, and only to the extent that such disclosure is reasonably necessary for the performance of its duties and obligations under this Agreement (or the determination or preservation of its rights under the Agreement)); provided , however , that the recipient shall take all reasonable measures to ensure that Confidential Information of the disclosing party is not disclosed or duplicated in contravention of the provisions of this Agreement by such officers, directors, partners, agents, professional advisors, contractors, subcontractors and employees.

(c) If either party intends to disclose any Confidential Information in connection with any claim or action to determine or preserve its rights under this Agreement, then that party will give prior notice to the other party and take such reasonable actions as may be specified by the other party to obtain a protective order or cause the Confidential Information to be filed under seal (or give the other party an opportunity to obtain a protective order).

(d) The obligations in this Section 8.1 shall not restrict any disclosure pursuant to any applicable law, regulation or by order of any court or government agency (provided that the recipient shall give prompt notice to the disclosing party of such order, shall disclose only such Confidential Information as the recipient is required to disclose under the applicable law or order, and shall take such reasonable actions as may be specified by the disclosing party at the disclosing party's cost to resist providing such access or to obtain a protective order), or any disclosure required by the rules of any national securities market, and shall not apply with respect to information that (1) is independently developed by the recipient without violating the disclosing party's proprietary rights, (2) is or becomes publicly known (other than through unauthorized disclosure by the receiving party), (3) is already known by the recipient at the time of disclosure without any obligation of confidentiality to the disclosing party, or (4) is disclosed to a party by a third person which the recipient reasonably believes has legitimate possession thereof and the unrestricted right to make such disclosure.

8.2 Unauthorized Acts . Without limiting either party's rights in respect of a breach of this Section, each party shall:

(i) promptly notify the other party of any unauthorized possession, use or knowledge, or attempt thereof, of the other party's Confidential Information by any person or entity that may become known to such party;

(ii) promptly furnish to the other party the details of the unauthorized possession, use or knowledge, or attempt thereof, known by such party and assist the other party in investigating or preventing the recurrence of any unauthorized possession, use or knowledge, or attempt thereof, of Confidential Information;

(iii) cooperate with the other party in any litigation and investigation against third parties deemed necessary by the other party to protect its proprietary rights; and

(iv) promptly use its commercially reasonable efforts to prevent a recurrence of any such unauthorized possession, use or knowledge, or attempt thereof, of Confidential Information.

Each party shall bear the cost it incurs as a result of compliance with this Section.

8.3 Confidential Information . For purposes of this Agreement, " Confidential Information " of a Party shall mean all information and documentation of such Party (or its Affiliates), whether disclosed to or accessed by the other Party (or its Affiliates) in connection with the activities contemplated by this Agreement that has been marked as "Proprietary" or "Confidential" or bears some other proprietary designation, or if disclosed orally or visually, has been designated by a party as confidential when disclosed and subsequently confirmed in a letter or other written statement or summary made to the other party within thirty (30) days of such disclosure, and shall include, without limitation:

(i) information concerning business plans,

(ii) financial information,

(iii) information concerning operations and the results of operations,

(iv) pricing information and marketing strategies,

(v) information that a party is legally obligated not to disclose,

(vi) information that qualifies as a trade secret under applicable law,

(vii) this Agreement,

(viii) patents, unpatented inventions and information regarding product development and improvements, and

(ix) material and performance specifications.

ARTICLE IX - STEERING COMMITTEE; DISPUTE RESOLUTION

9.1 Steering Committee

(a) The Parties shall establish and maintain throughout the term of this Agreement a committee (the " Steering Committee ") to oversee the implementation and operation of this Agreement. The Steering Committee shall consist of four people. Seller shall be entitled to appoint two members of the Steering Committee and Buyer shall be entitled to appoint two members of the Steering Committee. The initial members of the Steering Committee appointed by Seller shall be the Managing Director of Europe, Africa and The Middle East and the Director of U.S. Sales of Seller, and the initial members of the Steering Committee appointed by Buyer shall be the Category Manager — Proppants and the Vice President of Production Enhancement of Buyer. Seller shall be entitled to remove and replace at any time one or more of the members of the Steering Committee appointed by Seller and Buyer shall be entitled to remove and replace at any time one or more of the members of the Steering Committee appointed by Buyer.

(b) The Steering Committee shall oversee the implementation and operation of this Agreement with the purpose of ensuring that each Party's relevant interests, as summarized in the Recitals to this Agreement, have and are being addressed in a satisfactory manner consistent with the broad principles of cooperation underlying the execution of this Agreement. If and to the extent the Steering Committee determines that such relevant interests are not being addressed in a fully satisfactory manner as contemplated herein, then they will attempt to agree on what action, if any, is required in view of their joint determination. Without limiting the foregoing, the Steering Committee shall meet to discuss:

A. Product purchase prices under this Agreement

B. Product lead times

C. Payment issues (past due, credit holds, etc)

D. Discuss pertinent end customer information

  1. Input from end customers relating to the Products

  2. Discuss end customer service issues and opportunities

E. Marketing & sales information

F. Evaluate and discuss market status and strategy

G. Delivery performance

H. Foreign Corrupt Practices Act and OFAC Compliance issues

For the avoidance of doubt, each Party will retain independent pricing authority and will determine on its own the pricing for its sales of Products to third parties.

(c) Unless otherwise agreed by the Parties, through their representatives on the Steering Committee, until the first anniversary of the Effective Date, the Steering Committee shall meet monthly at a mutually agreed date and location to review the Parties' performance under this Agreement. Following the first anniversary of the Effective Date, the Steering Committee shall meet as agreed upon by the Parties, through their representatives on the Steering Committee, but in no event shall the Steering Committee meet less than quarterly.

Section 9.2 Dispute Resolution

(a) In the event of a dispute arising out of or relating to this Agreement, including but not limited to the existence and resolution of an alleged Material Breach (a " Dispute "), the Parties will endeavor in good faith to mutually resolve on a commercially reasonable basis such Dispute. Either Party may initiate an attempt to mutually resolve a Dispute by sending written notice of the Dispute to the other Party (the " Dispute Notice "). During the Parties' attempts to mutually resolve a Dispute, the following groups of individuals shall separately meet in person or by telephone: (i) Steering Committee representatives from both Parties, (ii) the Vice President of Marketing and Sales, on behalf of Seller, and Director Marketing and Development Completions and Production, on behalf of Buyer, and (iii) the Senior Vice President and Chief Financial Officer, on behalf of Seller, and the Senior Vice President Completions and Production, on behalf Buyer. Any Dispute that cannot be mutually resolved in accordance with this paragraph (a) within ninety (90) days of the date of the Dispute Notice may be referred by either Party to binding arbitration, as follows.

(b) The Dispute, if referred by either Party to arbitration shall be fully and finally resolved under the Commercial Arbitration Rules of the American Arbitration Association (" AAA ") which are in effect as of the date of this Agreement (the " Rules "). The arbitral tribunal shall be composed of three (3) arbitrators. Each Party shall appoint one (1) arbitrator, and the two (2) arbitrators thus appointed shall appoint the third arbitrator. If a Party fails to appoint its arbitrator within thirty (30) days of the receipt by the respondent of the demand for arbitration, or if the two (2) party-appointed arbitrators cannot agree on the third arbitrator within a period of thirty (30) days after appointment of the third arbitrator, then the arbitrator of the failing Party and/or the third arbitrator shall be appointed by the AAA within thirty (30) days thereafter. The third arbitrator shall serve as chair of the arbitral tribunal.

(c) The arbitration shall take place in Dallas, Texas, unless the Parties otherwise agree. The arbitration shall be conducted in the English language and the award shall be rendered in English. The award shall be a reasoned award and shall be in writing. In the award, the arbitral tribunal may apportion fees, expenses, compensation, and attorneys' fees among the parties in such amounts as the arbitral tribunal determines is appropriate. The award shall be final and binding on the Parties, and may be enforced and judgment entered thereon in any state or federal court located in the State of Texas or elsewhere having jurisdiction thereof or having jurisdiction over any of the Parties or any of their assets.

(d) The Parties agree that any monetary award shall be made and payable in U.S. Dollars, through a bank selected by the recipient of the award, together with interest thereon at a monthly rate equal to 1% of the unpaid balance from the date the award is granted to the date it is paid in full.

(e) By agreeing to arbitration, the parties do not intend to deprive any court of competent jurisdiction of its ability to issue any form of provisional remedy, including but not limited to a preliminary injunction or attachment in aid of the arbitration, or order any interim or conservatory measure. A request for such provisional remedy or interim or conservatory measure by a party to a court shall not be deemed a waiver of this agreement to arbitrate.

(f) Notwithstanding anything to the contrary herein, the arbitration provisions set forth herein, and any arbitration conducted thereunder, shall be governed exclusively by the Federal Arbitration Act, Title 9 United States Code, to the exclusion of any state or municipal law of arbitration.

ARTICLE X - ADDITIONAL REPRESENTATIONS

(a) As used in this ARTICLE X, the definitions listed below shall have the following meanings:

(i) " **Agent** " means (i) any Person appointed by a power of attorney or similar instrument granted by the Seller empowering that Person to represent Seller with regard to the Products, and (ii) any agent, sales representative, sponsor or other Person appointed or retained to assist the Seller to obtain or retain business or to promote the distribution, marketing or sales of the Products, including licensing agreements pursuant to which any Person distributes, markets or sells the Products.

(ii) " **Anti-Corruption Laws** " means, collectively, (i) the United States Foreign Corrupt Practices Act (FCPA), (ii) laws enacted pursuant to the Organization of Economic Cooperation and Development (OECD) Convention on Combating Bribery of Foreign Public Officials in International Business Transactions, and (iii) any other applicable laws of relevant jurisdictions prohibiting bribery and corruption.

(iii) " **Government Official** " means (i) any officer, employee or agent of any government (including any government of any country or any political subdivision within a country) or of any department, agency or instrumentality (including any business or corporate entity owned or managed by a government, such as a national oil company or subsidiary thereof) thereof, or any Person acting in an official capacity or performing public duties or functions on behalf of any such government, department, agency or instrumentality, (ii) any political party or official thereof, (iii) any candidate for public office, or (iv) any officer, employee or agent of a public international organization, including, but not limited to, the United Nations, the International Monetary Fund or the World Bank.

(iv) " **Prohibited Payment** " means any payment or provision of money or anything of value (including any loan, reward, advantage or benefit of any kind), either directly or indirectly, to any Government Official or family member of any Government Official, to influence any act, decision or omission of any Government Official, to obtain or retain business, to direct business to the Seller or Buyer or to gain any advantage or benefit for the Seller or Buyer. Prohibited Payments do not include: (i) any facilitating payment to a Government Official the purpose of which is to expedite or to secure the performance of a routine governmental action, or (ii) a reasonable and *bona fide* expenditure, such as travel and lodging expenses, incurred by or on behalf of a Government Official that is directly related to the execution or performance of a contract with a foreign government or agency.

(v) " **US Trade Laws** " means, collectively, (i) the Export Administration Regulations (including but not limited to prohibitions against complying with any unsanctioned foreign boycott) administered by the United States Department of Commerce, (ii) the International Traffic in Arms Regulations administered by the United States Department of State, (iii) the trade and economic sanctions administered by the Office of Foreign Assets Control of the United States Treasury Department and (iv) any other applicable law regulating trade by U.S. companies or in U.S. items, services or technology.

(b) Seller represents and warrants that it will comply with all applicable laws, including but not limited to applicable Anti-Corruption Laws and US Trade Laws, relating to the conduct of its business practices in connection with its performance under this Agreement, including those that proscribe gratuities, inducements, or Prohibited Payments. Seller specifically acknowledges that Buyer is subject to the United States Foreign Corrupt Practices Act of 1977 and its amendments (the " FCPA "). In addition, Seller represents that: (i) no individual director, officer, or, to its knowledge, employee of the Seller that is regularly involved in the performance of this Agreement, nor to its knowledge, any spouse of any such individual director, officer, or employee of the Seller, is a Government Official; (ii) it will not make or authorize any charitable or political contribution in the name of Buyer without the prior consent of Buyer; (iii) in the course of the performance of this Agreement, it will not make or authorize any Prohibited Payment; and (iv) in the course of the performance of this Agreement, it will not make or authorize the giving of money or anything of value, directly or indirectly, to any Person while knowing or being aware of a high probability that all or a portion of such money or thing of value would be used to make a Prohibited Payment; and (v) none of its Agents has been retained for the express purpose of obtaining or retaining business for Buyer that would cause Buyer to purchase Products under this Agreement.

(c) Buyer represents and warrants that it will comply with all applicable laws, including but not limited to applicable Anti-Corruption Laws and US Trade Laws, relating to the conduct of its business practices in connection with its performance under this Agreement, including those that proscribe gratuities, inducements, or Prohibited Payments. Buyer specifically acknowledges that Seller is subject to the FCPA. In addition, Buyer represents that: (i) no director, officer or, to its knowledge, employee of Buyer that is regularly involved in the performance of this Agreement, nor to its knowledge, any spouse of an individual director, officer, or employee of the Buyer, is a Government Official ; (ii) it will not make or authorize any charitable or political contribution in the name of Seller without the prior consent of Seller; (iii) in the course of the performance of this Agreement, it will not make or authorize any Prohibited Payment; and (iv) in the course of the performance of this Agreement, it will not make or authorize the giving of money or anything of value, directly or indirectly, to any Person while knowing or being aware of a high probability that all or a portion of such money or thing of value would be used to make a Prohibited Payment.

ARTICLE XI - MISCELLANEOUS

11.1 Entire Agreement. THIS AGREEMENT, INCLUDING THE EXHIBITS ATTACHED HERETO AND INCORPORATED AS AN INTEGRAL PART OF THIS AGREEMENT, CONSTITUTES THE ENTIRE AGREEMENT OF THE PARTIES WITH RESPECT TO THE SUBJECT MATTER HEREOF, AND SUPERSEDES ALL PREVIOUS AGREEMENTS BY AND BETWEEN BUYER AND SELLER AS WELL AS ALL PROPOSALS, ORAL OR WRITTEN, AND ALL NEGOTIATIONS, CONVERSATIONS OR DISCUSSIONS HERETOFORE HAD BETWEEN THE PARTIES RELATED TO THIS AGREEMENT, INCLUDING WITHOUT LIMITATION, THAT CERTAIN LETTER AGREEMENT, DATED AUGUST 17, 2007, SENT BY SELLER TO BUYER.

11.2 Applicable Law; Survival. This Agreement shall be governed and controlled as to validity, enforcement, interpretation, construction, effect and in all other respects by the internal laws of the State of Delaware applicable therein, without giving effect to the conflicts of laws principles thereof, and specifically excludes the U.N. Convention on Contracts for International Sale of Goods. The provisions of Section 4.3, the last sentence of Section 6.3, Article VIII, Section 9.2 and Article XI shall survive any termination of this Agreement.

11.3 Amendments; Independent Contractors. This Agreement may not be amended, nor shall any waiver, change, modification, consent or discharge be affected, except by an instrument in writing executed by or on behalf of the party against whom enforcement of any such amendment, waiver, change, modification, consent or discharge is sought. The Parties hereto intend by this Agreement solely to act as independent contractors with respect to each other, and no other relationship is intended to be created hereby.

11.4 Severability. The invalidity of any provision of this Agreement, or portion thereof, shall not affect the validity of the remainder of such provision or of the remaining provisions of this Agreement.

11.5 Section Headings. The headings contained in this Agreement are for reference purposes only and shall not in any way affect the meaning or interpretation of this Agreement.

11.6 Assignability. This Agreement may not be assigned or transferred by a Party without the prior written consent of the other Party. In the event of a permitted assignment hereunder, the assigning Party shall, at the election of the non-assigning Party, provide a guarantee in respect of the relevant assignee, in form and substance satisfactory to the non-assigning Party which approval shall not be unreasonably withheld or delayed.

11.7 Notice. All notices required or permitted to be given hereunder shall be in writing and shall be deemed given (a) when delivered in person at the time of such delivery or by facsimile with confirmed receipt of transmission at the date and time indicated on such receipt or (b) when received if given by an internationally recognized express courier service as follows, or at such other respective addresses or addressees as may be designated by notice given in accordance with the provisions of this Section 11.7:

If to Buyer:
Halliburton Energy Services Inc.
10200 Bellaire Blvd., Suite 2NE,
Houston, Texas 77072
Attention: Category Manager- Proppants
Fax No.: 281-575-5775

with a copy to:
Halliburton Energy Services Inc.
10200 Bellaire Blvd., Suite 2NE,
Houston, Texas 77072
Attention: VP- Law
Fax No.: 281-575-5589

If to Seller:
CARBO Ceramics Inc.
9949 W. Sam Houston Parkway North
Houston, Texas 77064
Attention: Vice President of Marketing and Sales
Fax No.: 281-257-9400

with a copy to:
CARBO Ceramics Inc.
6565 N. MacArthur Blvd., Suite 1050
Irving, Texas 75039
Attention: Chief Financial Officer
General Counsel
Fax No.: 972-401-0705

11.8 Non-Waiver. Failure, delay or forbearance of either party to insist on strict performance of the terms and provisions of this Agreement, or to exercise any remedy, shall not be construed as a waiver thereof and shall not waive subsequent strict performance by a party.

11.9 Further Assurances. Each Party will use all reasonable efforts to take, or cause to be taken, all actions and to do, or cause to be done, all things reasonably necessary or desirable under applicable law and otherwise to consummate the transactions contemplated by this Agreement and to refrain from taking any action that would prevent or delay the consummation of such transactions. Each Party will execute and deliver such other documents, certificates, agreements and other writings and take such other actions as may be reasonable and necessary or desirable in order to consummate by it the transactions contemplated by this Agreement.

11.10 Illegality and Severability. If application of any one or more of the provisions of this Agreement shall be unlawful under applicable law and regulations, then the Parties will attempt in good faith to make such alternative arrangements as may be legally permissible and which carry out as nearly as practicable the terms of this Agreement. Should any portion of this Agreement be deemed unenforceable by a court of competent jurisdiction, the remaining portion hereof shall remain unaffected and be interpreted as if such unenforceable portions were initially deleted.

11.11 Captions . The captions in this Agreement are included for convenience or reference only and shall be ignored in the construction or interpretation hereof.

11.12 Counterparts . This Agreement may be executed in multiple counterparts, each of which shall be deemed to be an original and all such counterparts shall constitute but one instrument.

11.13 Benefit of Agreement . The rights and obligations of Buyer under this agreement shall inure to each of the Buyer Beneficiaries, each of which is an Affiliate of Buyer. In the event any of the Buyer Beneficiaries no longer meets the definition of an Affiliate of Buyer, it will automatically and without further action will no longer be subject to the rights and obligations of this Agreement. Except as specifically set forth herein, this Agreement does not confer any enforceable rights or remedies upon any person or entity, other than the Parties. Notwithstanding the foregoing, each Buyer Beneficiary must execute and deliver to Seller or its designated Affiliate the form of Affiliate Addendum attached hereto as Exhibit A before it is entitled to purchase CARBO Products pursuant to this Agreement.

11.14 Disclaimer of Consequential Damages. NOTWITHSTANDING ANYTHING TO THE CONTRARY CONTAINED IN THIS AGREEMENT, NEITHER PARTY SHALL UNDER ANY CIRCUMSTANCES BE LIABLE TO THE OTHER FOR CONSEQUENTIAL, INCIDENTAL, SPECIAL OR EXEMPLARY DAMAGES ARISING OUT OF OR RELATED TO ANY TRANSACTION CONTEMPLATED UNDER THIS AGREEMENT, WHETHER IN AN ACTION BASED ON CONTRACT, TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR ANY OTHER LEGAL THEORY, INCLUDING, BUT NOT LIMITED TO, LOSS OF ANTICIPATED PROFITS OR BENEFITS OF USE OR LOSS OF BUSINESS, EVEN IF A PARTY IS APPRISED OF THE LIKELIHOOD OF SUCH DAMAGES OCCURRING.

[Remainder of page left intentionally blank;
Signature page follows]

IN WITNESS WHEREOF, the Parties have executed this Agreement as of the date first above written.

CARBO CERAMICS INC.

By: /s/ Gary A. Kolstad
Name: Gary A. Kolstad
Tile: President & CEO

HALLIBURTON ENERGY SERVICES INC.

By: /s/ Jonathan Lewis
Name: Jonathan Lewis
Tile: Vice President, WPS

EXHIBIT A - AFFILIATE ADDENDUM

The following shall be the form of agreement executed by the Buyer Beneficiaries (hereinafter referred to as "Buyer Affiliate"), and if necessary for the purposes of local law, the foreign Affiliates of Seller pursuant to Article 2.1 of the Agreement. Otherwise, Seller may sign this Agreement directly with each Buyer Beneficiary in place of a Seller Affiliate, or elect to have the Agreement signed by a Seller Affiliate.

AFFILIATE ADDENDUM

This Affiliate Addendum ("Addendum") is made on ___(the "Effective Date") by and between:

_____________________, whose principal offices are located at __________("Buyer Affiliate"), and whose principal offices are located at __________("Seller" or "Seller Affiliate").

WHEREAS, Buyer Affiliate wishes to purchase Product from Seller Affiliate and Seller Affiliate is willing to sell the Product pursuant to the terms and conditions set forth in this Addendum.

NOW, THEREFORE, Seller Affiliate and Buyer Affiliate, in consideration of the mutual covenant contained herein, and for other good and valuable consideration, the receipt of which is hereby acknowledged, agree as follows:

1. This Addendum adopts and incorporates by reference all of the terms and conditions of the Proppant Supply Agreement, including all attachments, exhibits, and subsequent amendments (if any) (the "Agreement") between Haliburton Energy Services, Inc. ("Halliburton") and CARBO Ceramics Inc. ("Seller") effective as of XXXXXXXXXXXXX ("Effective Date").

2. All capitalized terms used in this Addendum and not otherwise defined shall have the meanings given to such terms in the Agreement.

3. Seller Affiliate and Buyer Affiliate agree that purchases of Product will be conducted in accordance with, and be subject to, in order of priority, the following terms and conditions: (i) this Addendum, (ii) the Agreement and (iii) any applicable Service Order or Purchase Order that is not in conflict or inconsistent with the Agreement and the other exhibits and attachments thereto. In the event that the Agreement is terminated, this Addendum shall terminate except in respect of CARBO Product previously ordered and accepted under this Addendum, which shall expire in accordance with the applicable Service Order for that particular purchase of Product. Unless otherwise agreed, sales of CARBO Product by Seller Affiliate under this Addendum shall be invoiced by Seller Affiliate to Buyer Affiliate in the currency permitted in Section 3.4 of the Agreement.

4. [INSERT ANY CHOICE OF LAW OR LOCAL SPECIFICS FOR THE COUNTRIES OF THE AFFILIATES.]

IN WITNESS WHEREOF, Seller Affiliate and Buyer Affiliate, through duly authorized representatives, have executed this Addendum as of the Effective Date set forth hereinabove.

[Remainder of page left intentionally blank;
Signature page follows]

By: ______________________

Name: ______________________

Tile: ______________________

By: ______________________

Name: ______________________

Tile: ______________________

Exhibit 10.3

EXHIBIT B

SELLER'S TERMS AND CONDITIONS

CARBO CERAMICS INC.
TERMS AND CONDITIONS OF SALE

1 . **AGREEMENT OF SALE, ACCEPTANCE** : Any acceptance contained herein is expressly made conditional on Buyer's assent to any terms contained herein that are additional to or different from those proposed by Buyer in its purchase order and, hence, any terms and provisions Buyer's purchase order which are inconsistent with the terms and conditions hereof shall not be binding on the Seller. Unless Buyer shall notify Seller in writing to, the contrary as soon as practicable after receipt hereof, acceptance of the terms and conditions hereof by Buyer shall be deemed made and, in the absence of such notification, the sale and shipment by the Seller of the goods covered hereby shall be conclusively deemed to be subject to the terms and conditions hereof.

2. **ENTIRE CONTRACT** : This contract constitutes the final and entire agreement between Seller and Buyer and any prior or contemporaneous understandings or agreements, oral or written, are merged herein.

3. **PRICES** : The price to be paid by Buyer shall be the price in effect at the date of actual delivery of the goods unless otherwise specified in writing by Seller.

4. **TAXES:** The price of the goods does not include sales, use, excise, ad valorem, property or other taxes now or hereafter imposed, directly or indirectly, by any governmental authority or agency with respect to the manufacture, production, sale, delivery, consumption or use of the goods covered by this contract. Buyer shall pay such taxes directly or reimburse Seller for any such taxes which it may be required to pay.

5. **PAYMENT** : The specific terms of payment are as specified in writing by Seller. If the Buyer shall fail to make any payments in accordance with the terms and provisions hereof, the Seller, in addition to its other rights and remedies, but not in limitation thereof, may, at its option, defer shipments or deliveries hereunder, or under any other contract with the Buyer, except upon receipt of satisfactory security or of cash before shipment.

6. **SHIPMENT; RISK OF LOSS; TITLE** : The goods shall be shipped f.o.b. Seller's shipping points. Risks of loss pass to Buyer upon delivery to the carrier. Title shall pass to Buyer on delivery to the carrier.

7 . **DELIVERIES** : The date of delivery provided herein is an approximation based on Seller's best judgment and prompt receipt from the Buyer of all necessary data regarding the goods. Unless otherwise expressly stated, Seller shall have the right to deliver all of the goods at one time or in portions from time to time within the time of delivery herein provided. The delivery of nonconforming goods, or a default of any nature, in relation to one or more installments of this contract shall not substantially impair the value of this contract as a whole and shall not constitute a total breach of the contract as a whole,.

8. **DELAYS IN DELIVERIES** : Seller shall, be excused for delay in delivery, may suspend performance and shall under no circumstances be responsible for failure to fill any order or orders when due to acts of God or of the public enemy: fires, floods, riots, strikes, freight embargoes or transportation delays, , inability to secure fuel, material supplies, or power on account of general market shortages thereof, any existing or future laws, or acts of the Federal or of any State Government (including superficially but not exclusively any orders, rules or regulations issued by any official or agency of any such government) affecting the conduct of Seller's business, any cause beyond Seller's reasonable control.

9. **WARRANTY** : Seller warrants that the goods manufactured by the Seller when shipped are free from defects in materials and workmanship, provided, however, Seller shall have no obligation or liability under this warranty unless it shall have received prompt written notice specifying such defect no later than one (1) year from the date of shipment. In the event of defects developing within that period under normal and proper use, Buyer agrees that its sole and exclusive remedy shall require only that the Seller, at its option, repair, modify or replace the non-

conforming goods f.o.b. Seller's plant or accept the return of the non-conforming goods and refund the purchase price or part thereof, giving effect to the use or value received by Buyer. No goods shall be returned to Seller without Seller's prior written consent. In no event will Seller be liable for any damages, including consequential damages, resulting from the use of the product.

THE WARRANTY SPECIFIED IN THIS PARAGRAPH IS THE SOLE AND EXCLUSIVE WARRANTY RELATING TO THE GOODS AND IS IN SUBSTITUTION FOR AND IN LIEU OF ANY AND ALL WARRANTIES, EXPRESS OR IMPLIED OR STATUTORY, INCLUDING THE WARRANTY OF MERCHANTABILITY AND THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AS WELL AS ANY WARRANTY ARISING FROM COURSE OF DEALING, PERFORMANCE OR USAGE OF TRADE.

10. LAWS, CODES, REGULATIONS, SAFETY DEVICES : Compliance with laws, codes and regulations relating to the goods and their uses is the sole responsibility of Buyer, and Seller makes no warranty or representation with respect thereto. Buyer assumes the responsibility for providing and installing any and all devices for protection, of safety, health and the environment and shall indemnify and hold harmless Seller against all expense, loss, or damage which Seller may incur or sustain as a result of Buyer's failure to do so, including associated legal costs and expenses. Buyer will not export or re-export the goods from the place and country of destination listed on Buyer's initial order form without Seller's express prior and express written permission.

11. PATENTS : Seller shall, at its own expense, assume the defense of any claim, suit or other proceeding brought against Buyer upon a claim that the goods furnished under this contract constitutes an infringement of any patent of the United States. Buyer agrees to cooperate in the defense of any such proceeding and to provide information, assistance and authority necessary, therefor. Should the goods in such suit be held to constitute infringement and the use of the goods enjoined, the Seller shall, at its own expense and at its option, procure for the Buyer the right to continue using such goods, replace them with substantially equivalent goods ,modify them so they become non-infringing or refund the applicable portion of Buyer's purchase price. Such actions shall constitute Seller's sole and exclusive obligation and liability with respect to infringement of intellectual property rights.

Buyer shall defend, hold harmless, and indemnify Seller against all judgments, decrees, costs and expenses arising out of any action against Seller or its suppliers based on a claim that the manufacture or sale of goods hereunder constitutes infringement of any United States letters patent, if such goods were manufactured pursuant to Buyer's proprietary designs, specifications and/or formulae and were not normally offered for sale by Seller, provided, however, Seller shall give prompt written notice of the claim or action and Seller shall give Buyer authority, information and assistance at Buyer's expense.

12. LIABILITY : **In no event shall Seller's obligation and liability under this contract extend to indirect, punitive, special, incidental or consequential damages or losses Buyer may suffer or incur in connection therewith, such as but not limited to loss of revenue or profits, damages or losses as a result of Buyer's inability to operate, or shut down of its plant or operations, loss of use of the goods or associated goods or cost of substitute goods, facilities or services, inability to fulfill contracts with third parties, injury to good will, claims of customers and the like, nor shall it extend to damages or losses Buyer may suffer or incur as a result of claims, suits or other proceedings made or instituted against Buyer by third parties, whether public or private in nature.**

13. BUYER'S DEFAULT; TERMINATION : Buyer shall be liable to Seller for all damages or losses, including loss of reasonable profits, and for costs and expenses, including attorney's fees, sustained by Seller and arising from Buyer's default under, or breach of, any of the terms and conditions of this contract. In the event of any such default or breach, Seller may, without any obligation or liability to Buyer, terminate this contract forthwith by written notice to Buyer and such action by Seller shall not be deemed a waiver of any right or remedy with respect to such default or breach.

14. ASSIGNMENT: No right or interest in this contract shall be assigned by Buyer without prior written agreement by the Seller. No delegation of any obligation owed, or the performance of any obligation by the Buyer shall be made without prior written agreement by the Seller.

15. LAW GOVERNING : The interpretation and performance of this contract shall be in accordance with and shall be controlled by the laws of the State of Texas, without reference to the conflict of laws provisions thereof, and specifically excludes the U.N. Convention on Contracts for International Sale of Goods.

16. MODIFICATIONS; WAIVER : No waiver, alteration or modification of any of the provisions hereof shall be binding on the Seller unless made in writing and agreed to by a duly authorized official of the Seller. No waiver by the Seller of any one or more defaults by the Buyer in the performance of any provisions of this contract shall operate or be construed as a waiver of any future default or defaults, whether of a like or of a different character.

17. ATTORNEY'S FEES : If suit or action is filed by Seller to enforce the provisions hereof or otherwise with respect to the subject matter of this contract, the Seller, in addition to its other rights and remedies, but not in limitation thereof, shall be entitled to recover reasonable attorneys' fees as fixed by the trial court, and if any appeal is taken from the decision of the trial court, reasonable attorneys' fees as fixed by the appellate court.

18. Import and Export Compliance. Seller agrees that, in performance under this Agreement, it is solely responsible for its required compliance with any applicable trade restriction and export laws and regulations of the United States and the jurisdiction in which Seller's shipment of goods originates. When the goods (or part thereof) are subject to export control laws and regulations imposed by the United States or a government where Seller's shipment originates, Seller will upon request provide Buyer with applicable Export Commodity Classification Numbers and harmonized Tariff Schedule Numbers per goods for export including certificates of manufacture in accordance with the origin rules imposed by such governmental authority. If said Goods are eligible for preferential tax or tariff treatment (such as free trade or international agreement), Seller will use reasonable efforts to provide Buyer with the documentation required to participate in said treatment to the extent such documentation is in Seller's possession and can be generated or provided by Seller's existing infrastructure systems and administrative staff.

19. Fair Labor Standards Act . Contractor shall comply with the Fair Labor Standards Act including the requirement to pay a statutory minimum wage to its employees. Pursuant to the 1986 Immigration Reform and Control Act, Contractor shall verify that each of its employees is authorized to work in the United States and shall require signed I-9 forms from each employee as well as proof of identity and authorization to work documents. Such I-9 forms will be maintained by Contractor as required by law and will be available for inspection by the Company upon the Company's written request to inspect such records

EXHIBIT C

DISTRIBUTION NETWORK

Arflow- located in Argentina

EXHIBIT D

GEOGRAPHIC REGIONS

i. USA Core Area 1 (TX - [excluding S. TX], LA, OK, AR, MS, KS)

ii. USA Area 2 (South TX)

iii. USA Area 3 (New Mexico)

iv. USA Area 4 (North Rockies - Williston)

v. USA Area 5 (South Rockies - Worland, Rock Springs)

vi. USA Area 6 (California)

vii. USA Area 7 (Alaska)

viii. USA Area 8 (North East)

ix. Canada-Alberta

x. Canada- British Columbia

xi. Canada- East Coast

xii. Mexico

xiii. Russia

xiv. China

xv. Other International

EXHIBIT E

SELLER PRODUCT LINES
AND BASE SELLING PRICE EXAMPLE

Seller Product Lines :

CARBO *ECONOPROP*®

CARBO *LITE* ®

CARBO *PROP* ®

CARBO *HSP* ®

CARBO *HYDROPROP* ™

CARBO *BOND* ®

Base Selling Price Example:

[***]

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UNITED STATES SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

FORM 10-Q

☑ **QUARTERLY REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the quarterly period ended March 31, 2011

or

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the transition period from __________ to __________.

Commission File No. 001-15903

CARBO CERAMICS INC.

(Exact name of registrant as specified in its charter)

DELAWARE (State or other jurisdiction of incorporation or organization)	**72-1100013** (I.R.S. Employer Identification Number)

575 North Dairy Ashford
Suite 300
Houston, Texas 77079
(Address of principal executive offices)

(281) 921-6400
(Registrant's telephone number)

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☑ No ☐

Indicate by check mark whether the registrant has submitted electronically and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit and post such files). Yes ☑ No ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer or a smaller reporting company. See the definitions of "large accelerated filer", "accelerated filer" and "smaller reporting company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer ☑ Accelerated filer ☐ Non-accelerated filer ☐ (Do not check if a smaller reporting company) Smaller reporting company ☐

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). Yes ☐ No ☑

As of April 25, 2011, 23,162,193 shares of the registrant's Common Stock, par value $.01 per share, were outstanding.

Exhibit 10.1

CONFIDENTIAL PORTIONS OF THIS EXHIBIT HAVE BEEN OMITTED AND FILED SEPARATELY WIH THE SECURITIES AND EXCHANGE COMMISSION UNDER A CONFIDENTIAL TREATMENT REQUEST. THE REDACTED TERMS HAVE BEEN MARKED IN THIS EXHIBIT AT THE APPROPRIATE PLACE WITH THREE ASTERISKS [***].

AMENDMENT NO. 1
TO THE
PROPPANT SUPPLY AGREEMENT

THIS AMENDMENT NO. 1 TO THE PROPPANT SUPPLY AGREEMENT (this " Amendment "), dated as of February 28, 2011, is entered into by and between CARBO Ceramics Inc., a Delaware corporation (" Seller "), and Halliburton Energy Services, Inc., a Delaware corporation (" Buyer "). Defined terms used herein, but not otherwise defined, shall have such meanings as are set forth in the Supply Agreement (as defined below).

RECITALS

WHEREAS, reference is herein made to that certain Proppant Supply Agreement by and between Seller and Buyer dated August 28, 2008 (the " Supply Agreement "); and

WHEREAS, Seller and Buyer desire to amend the Supply Agreement as set forth herein in accordance with Section 11.3 of the Supply Agreement.

AGREEMENT

NOW, THEREFORE, in consideration of the premises, the mutual covenants and agreements contained herein and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Buyer and Seller hereby agree as follows:

1. Amendments to the Supply Agreement .

(a) Article I . The definition " Prioritize " in Article I of the Supply Agreement is hereby amended and restated in its entirety by the following:

> " Prioritize " means that in the event of applicable Seller Product shortages, Seller shall use commercially reasonable efforts to fill the orders of Buyer and the Buyer Beneficiaries before orders from other parties for the identical Product made under similar circumstances, including the Geographic Region for which the order is placed. Buyer and Seller agree that Seller shall have satisfied its obligation to use commercially reasonable efforts hereunder if Seller makes available to Buyer in one or more Geographic Regions a percentage of Seller's actual annual manufactured output as follows in the table below; provided , however , that in no event shall Seller's commercially reasonable efforts require it to provide more than [***] of Product multiplied by the applicable percentage of actual manufactured output set forth in the table below:

Calendar Year	Percentage of Actual Manufactured Output
2011	[***]%
2012	[***]%
2013 and each calendar year thereafter during the term of the Agreement	[***]%

(b) Section 2.1 . Section 2.1 of the Supply Agreement is hereby amended and restated in its entirety by the following:

"2.1 Agreement to Purchase Products . Beginning on the Effective Date and throughout the term of this Agreement, Buyer hereby agrees that it and its Affiliates shall purchase at least [***]% of their total global Product requirements from Seller each calendar year, as further described herein (the " Purchase Commitment "). In addition, Buyer and its Affiliates shall use commercially reasonable efforts to purchase at least [***]% of their total international Product requirements (excludes the United States) from Seller each calendar year. Notwithstanding the foregoing, in no event shall Buyer or its Affiliates be prohibited from purchasing products on the market from third parties which are similar to the Products, even if such third party is a competitor of Seller. Each Buyer Beneficiary shall execute an Affiliate Addendum before being able to purchase CARBO Products under the terms of this Agreement, using the form set forth herein as Exhibit A . Each Affiliate Addendum shall (a) incorporate the terms of this Agreement, and (b) contain such other provisions as may be reasonably necessary to comply with the applicable laws and regulations of the jurisdiction in which the Buyer Beneficiary is located."

(c) Section 3.1 . Section 3.1 of the Supply Agreement is hereby amended and restated in its entirety by the following:

"3.1 Selling Price .

(a) Seller shall sell, and shall cause its Affiliates to sell, each CARBO Product to Buyer or the Buyer Beneficiaries, as applicable, at the then current Base Selling Price, less any discount set forth in Section 3.2 below. Base Selling Prices shall be calculated for each Seller Product Line on a three-month basis for each Geographic Region and Seller shall send Buyer a written report that sets forth the Base Selling Price by Seller Product Line in each Geographic Region (a " Pricing Report "), as set forth in the table below; provided , however , that the Pricing Report delivered to Buyer on March 1, 2011, shall be based on the period commencing on January 1, 2011, and ending on February 28, 2011. The Base Selling Price in each Pricing Report shall be effective on the first day of the month following delivery of the Pricing Report to Buyer by Seller.

Period Basis for Pricing Report	Delivery Date of Pricing Report	Effective Date of Pricing Report
December 1 — February 28 (February 29, as applicable)	March 1	April 1
March 1 — May 31	June 1	July 1
June 1 — August 31	September 1	October 1
September 1— November 30	December 1	January 1

(b) From time to time during the term of this Agreement, Buyer and Seller may also enter into special written pricing arrangements for Seller Product Lines in particular Geographic Regions. Any such arrangements shall be specified in a written document executed by both Parties."

(d) Section 3.2 . Section 3.2 of the Supply Agreement is hereby amended and restated in its entirety by the following:

"3.2 Discount . During the term of this Agreement, Buyer and Buyer Beneficiaries shall receive a [***]% discount from the Base Selling Price for each Seller Product sold pursuant to this Agreement."

(e) Section 3.3 . Section 3.3 of the Supply Agreement is hereby deleted in its entirety and replaced with " **[Intentionally omitted.]** ," and all references to Section 3.3 in the Supply Agreement are hereby deleted.

(f) Section 4.1 . In order to correct an error in the equation to calculate Actual Purchase Percentage in Section 4.1 of the Supply Agreement, "100%" is hereby replaced with "100" in such equation.

(g) Section 6.1 . Section 6.1 of the Supply Agreement is hereby deleted in its entirety and replaced with " **[Intentionally omitted.]** ," and all references to Section 6.1 in the Supply Agreement are hereby deleted.

(h) Section 7.1 . Section 7.1 of the Supply Agreement is hereby amended and restated in its entirety by the following:

"7.1 Term . The term of this Agreement shall be for a period beginning on the Effective Date and ending on January 15, 2016, unless earlier terminated in accordance with the provisions of this Agreement or extended by agreement of the Parties. Unless provided otherwise in this Agreement, upon termination of this Agreement, neither Party shall have any liability or obligation under this Agreement of any kind."

2. Ratification . Except as expressly modified and amended by this Amendment, the Supply Agreement is ratified and confirmed in all respects and shall continue in full force and effect.

3. Governing Law . This Amendment shall be governed and controlled as to validity, enforcement, interpretation, construction, effect and in all other respects by the internal laws of the

State of Delaware applicable therein, without giving effect to the conflicts of laws principles thereof, and specifically excludes the U.N. Convention on Contracts for International Sale of Goods.

4. Counterparts . This Amendment may be executed in multiple counterparts, each of which when so executed shall be deemed an original and all of which shall constitute one and the same agreement.

[***Signature Page Follows***]

IN WITNESS WHEREOF, the parties hereto have executed this Amendment on the date first above written.

SELLER:

CARBO CERAMICS INC.

By: /s/ Gary Kolstad
Name: Gary Kolstad
Title: President and Chief Executive Officer

BUYER:

HALLIBURTON ENERGY SERVICES, INC.

By: /s/ David M. Adams
Name: David M. Adams
Title: Vice President

Signature Page — Amendment No. 1 to the Proppant Supply Agreement