



Non-radioactive detectable proppant for flowback identification

FEATURES

- Non-radioactive taggant that can be added to any CARBO proppant during manufacturing.
- More than 20 taggants available.
- Upon flowback, the taggant is easily identified with routine analysis.



Tagged Proppant for Flowback Identification

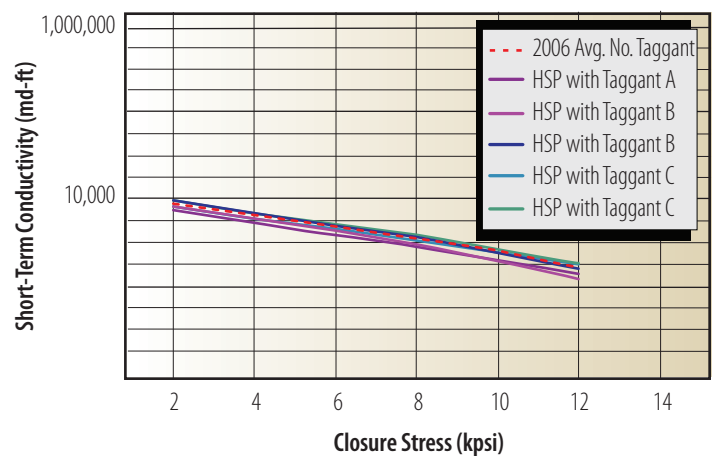
CARBOTAG® is a suite of more than 20 unique chemical markers that can be added to any CARBO proppant during manufacturing, which allows an operator to identify the precise well or fracture stage that flows back proppant. These taggants are not radioactive; rather they are naturally occurring chemical markers blended into the ceramic ore – therefore, these identifiers are part of the ceramic pellet, and do not degrade over time. **CARBOTAG** was first developed for offshore completions in the Gulf of Mexico to identify completion failures on an offshore platform. If **CARBOTAG** proppant is found in a common separation facility, it can be easily determined which fracture is allowing proppant to flow to the surface.

Physical Properties

CARBO Ceramics uses a patented process to add a unique material to any of its existing lines of proppants. These additives, called “taggants,” are naturally occurring chemical markers. Since the taggants are non-radioactive, they do not present any unique health hazards, nor any additional handling requirements. The MSDS documents remain unchanged.

Furthermore, since they are added in trace concentrations during the manufacturing process, these taggants do not alter the physical properties of the proppant. Although the tagging materials are present in extremely low concentrations, the unique markers can be easily identified with routine chemical analyses of a flowback sample, including x-ray fluorescence (XRF) and inductively coupled plasma (ICP) analysis.

Short-Term Conductivity Comparison - 20/40 HSP



Availability

While CARBO Ceramics has identified as many as 50 unique taggants available, there are practically 20-25 economic taggants available for incorporation into **CARBOTAG** proppants. All can be identified using the same chemical test. Since **CARBOTAG** proppants are “made-to-order,” it typically takes at least one month from the moment that a taggant is selected until the custom **CARBOTAG** proppant is delivered to the wellsite. These 20+ taggants can be incorporated into any of CARBO’s products and many size distributions, resulting in a broad range of potential combinations of taggant, proppant and size.



	Typical 20/40 CARBOHSP	Taggant A Typical 20/40 CARBOHSP	Taggant B Typical 20/40 CARBOHSP	Taggant C Typical 20/40 CARBOHSP
BD [g/cm ³]	1.94 - 2.02	1.95	1.96	1.94
ASG [g/cm ³]	3.42 - 3.54	3.51	3.51	3.50
%Crush @15Kpsi	3 - 5	890	4.7	3.9
Sieve Analysis (%)				
16	0	0.0	0.0	0.0
20	0 - 5	2.2	1.9	1.7
25	28 - 48	36.1	35.0	34.5
30	34 - 54	46.6	46.8	51.3
35	10 - 20	14.8	15.9	12.2
40	0 - 1	0.2	0.3	0.3
50	0	0.0	0.0	0.0
Pan	0	0.0	0.0	0.0

Addition of trace amounts of taggant does not affect the proppant performance – tagged proppants meet all typical specifications.

Potential Uses

CARBOTAG was originally developed at the request of a Gulf of Mexico operator who wished to identify the source of gravel pack screen failures in an offshore platform in which the wells were commingled. Previously, when proppant was observed in a central platform separator, it required extensive diagnostics, wellwork and downtime to determine precisely which well and interval was producing proppant. Incorporation of uniquely tagged proppant in each interval would allow the operator to quickly and efficiently identify the failed completion.

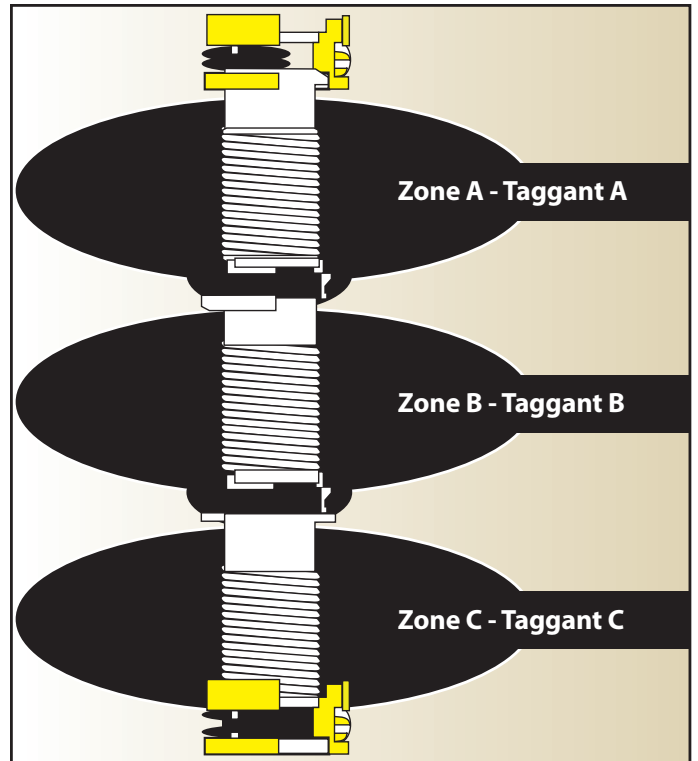
There are several other potential applications for **CARBO**TAG:

- Determination of the source of proppant flowback in wells with multiple stage fracs or on platforms with commingled production from multiple wells.
- On a single fracture treatment, different taggants can be used in each slurry stage. If proppant subsequently flows back, it can be determined which stages are targets for resin consolidation or other flowback additives.
- Identification of which stages flow back may also assist in understanding proppant transport and deposition within the fracture to improve future fracture designs.

Since the taggants are non-radioactive, there is no “shelf-life” associated with their use – the taggant can be identified at any time in the future if proppant flowback begins at a later date, perhaps coinciding with waterflood breakthrough or reaching the dew point.

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Selection/Manufacturing Process

CARBO Ceramics staff works closely with clients to determine the best **CARBO**TAG proppant for their completions. The necessary products (both taggants and proppants) are tailored for the specific application identified by the operator. Once the appropriate products and quantities are identified, a custom production run is scheduled into one of our manufacturing plants. Specific volumes and taggants are made using the same quality control and assurances that have made our proppants the industry standard.

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