Scrud Remover™

In Situ Remedy for Wells and Aquifers Fouled from certain EVO Amendments

PROBLEM STATEMENT

Application of certain emulsified vegetable oil (EVO) substrates can cause well clogging and aquifer fouling (**Photograph 1**). These negative effects can be long-lasting and wide-ranging. For example, at an active US DOD facility in southern California significant well clogging by thickly coagulated EVO "crud" was observed more than 6 years post-application of a common EVO amendment (personal communication – NOREAS; see inset of fouled well). In addition, aquifer fouling by EVO "scum" is probable at some unknown distance from the points of injection. This scum/crud is collective referred to herein as "Scrud".

Photograph 1: EVO Scum (left) and EVO Crud (right) recovered from EVO-Treated Injection well, Six years after Initial EVO applications.

The scrud formation phenomenon can have significant, negative impact on:

1. Accurate, Defensible Monitoring: fouled and otherwise occluded wells may not yield formation water representative of *in situ* conditions, and the scrud can sequester contaminants that will eventually release and rebound;

2. Remedial Efficacy: many EVO field applications are designed for repeat injections though dedicated wells. If the wells are compromised they cannot serve the designed purpose without replacement or extensive redevelopment, which represents added time and expense;

3. Remedial Performance: aquifer fouling can limit amendment distribution, induce unpredictable changes in aquifer hydrology and biogeochemistry, and increase remediation times.

Efforts to physically flush with water the EVO amendments from injection wells immediately following their application can help prevent the formation of well crud, but they likely have minimal effect on the formation of aquifer scum. And not all EVO-type substrates elicit the extreme response noted above. For example, amendments rich in fatty acids and low in "butterfat" such as ABC® based products (Redox Tech) and ERD CH4® products (Provectus) have not had well crud reports from over 300 field applications.

Unfortunately, there are no established procedures or measurements to predict situations were well crud and/or aquifer scum formation will be most problematic. Intuitively, aquifers with harder water (*e.g.,* magnesium / calcium > 150 ppm) and elevated concentrations of sodium (*e.g.*, > 200 ppm) and/or iron (*e.g.*, > 25 ppm) would be most susceptible to scrud formation.

TRADITIONAL WELL REHABILITATION PROCESSES

Effective removal of coagulated EVO crud and scum often requires specialized mitigation technologies, as conventional approaches have been mostly ineffective and costly.

- Physical Rehabilitation: Conventional means of aggressive physical scrubbing followed by extensive development. Depending on degree of fouling and well construction, this can be a labor-intensive (between 2 to 8 hours per well) and costly process that could exceed $5,000 per well.

- pH Treatment: The utilization of caustic (pH>10) or acid (pH<2) conditions does not solubilize all EVO cruds evaluated to date. Moreover, there are inherent potential health and safety issues with material handling, and the creation of pH extremes is simply not conducive to desired aquifer biological attenuation processes.

- Heat Treatment: Heated water >60 ºC (140 ºF) can solubilize some forms of EVO crud. However, upon cooling the crud will again coagulate hence heat will have less impact on aquifer scum. To avoid simple relocation of the problem from crud to scum the heated water must be quickly removed, and multiple heating events will likely be required. Moreover, the process can be difficult to implement, and will likely incur high implementation cost.

- Oxidation: The use of chemical oxidants such as hydrogen peroxide can solubilize some forms of EVO crud. However, the addition of oxidants is counterproductive to reductive dechlorination reactions.

- Surfactant Flushing: In our studies, ionic or non-ionic surfactants are not consistently robust for solubilizing well crud, especially at ambient temperatures.

SCRUD REMOVER™ TECHNOLOGY DESCRIPTION

Scrud Remover™ was developed by Redox Tech, LLC (Cary, NC) and Provectus Environmental Products, Inc. (Freeport, IL) in response to industry demand for a safe, effective means of rehabilitating wells and injection points rendered ineffective or useless by extensive fouling post high-fat EVO application. Like all

our environmental products, Scrud Remover™ was developed by experienced remedial practitioners with a focus on safety, effectiveness, reliability, ease-of-use, and cost. The efficacy of Scrud Remover™ is enhanced by heat, but heating is not required.

Antimethanogenic Scrud Remover™ Where applicable, antimethanogenic reagent (AMR) technology is uniquely integrated into Scrud Remover™. While other materials to dissolve scrud will predictably follow, these will likely contain very readily biodegradable organic compounds that will rapidly ferment and liberate methane. In areas sensitive to potential plume migration, vapor intrusion, and other consequences associated with excessive methanogenesis the integrated use of AMR technology may be an important technical differentiator.

SCRUD REMOVER™ MODE OF ACTION

Scrud Remover™ was developed through extensive testing of commercially available cleaning agents, ionic and nonionic surfactants, solvents, acids, bases and chelating agents. Individually, none of the materials were always effective at removing the scrud. Also, when some of the heated products dissolved the scrud, the scrud reformed upon cooling. Scrud Remover™ is a proprietary, environmentally friendly, multi-faceted product that removes scrud under ambient conditions (no heat required). To our knowledge, no other similar product exists in the marketplace.

SCRUD REMOVER™ APPLICATION GUIDELINES

1. Physically remove as much of the residual EVO and crud by bailing or pumping. Dispose as regulations require.

2. Prepare specialized anaerobic chase water composed of 5 USG Scrud Remover Part B (supplied with Scrud Remover) to 95 USG water.

3. Well Crud Removal
   - For a 1-inch well, add at least 0.25 USG of neat Scrud Remover™ per 1 linear foot of well screen. Let stand for 90 minutes. Flush with a minimum 2 USG of specialized chase water per 1 linear foot of well screen.
   - For a 2-inch well, add at least 1 USG of neat Scrud Remover™ per 1 linear foot of well screen. Let stand for 90 minutes. Flush with a minimum 4 USG of specialized chase water per 1 linear foot of well screen.
   - For a 4-inch well, add at least 4 USG of neat Scrud Remover™ per 1 linear foot of well screen. Let stand for 90 minutes. Flush with a minimum 16 USG of specialized chase water per 1 linear foot of well screen.
   - For a 6-inch well, we add at least 9 USG of neat Scrud Remover™ per 1 linear foot of well screen. Let stand for 90 minutes. Flush with a minimum 36 USG of specialized chase water per 1 linear foot of well screen.

   A follow-up injection test / falling head test is recommended to confirm to document well improvement. Repeat treatment as needed.

4. Aquifer Scum Treatment
   - For a 1-inch well, add at least 5 USG of neat Scrud Remover™ per 1 linear foot of well screen. For a 2-inch well, add at least 20 USG of neat Scrud Remover™ per 1 linear foot of well screen. For a 4-inch well, add at least 40 USG of neat Scrud Remover™ per 1 linear foot of well screen. For a 6-inch well, we add at least 60 USG of neat Scrud Remover™ per 1 linear foot of well screen.
   - Flush with specialized chase water targeting >2.5 percent of the estimated pore volume within the radius of influence.

   A follow-up injection test / falling head test is recommended to confirm renewed permeability. Repeat treatment as needed.

SCRUD REMOVER™ ORDERING INFORMATION

Scrud Remover™ is available in 5 USG pails, 50 USG drums, and totes (275 to 330 usg) and ships with requisite amount of Scrud Remover Part B needed to prepare specialized anaerobic chase water. All orders are processed through Redox Tech, LLC at the following address:

REDOX TECH, LLC
"Providing Innovative In Situ Soil and Groundwater Treatment"

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Cary, NC 27513
Phone: (919) 678.0140 Fax: (919) 678.0150
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CONTACT US FOR A COMPLIMENTARY SITE EVALUATION

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