

NEW REDUCE, REUSE, RECYCLE DRILLING WASTE TREATMENT TECHNOLOGIES AND PROGRAMS

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ABSTRACT

New waste treatment and disposal practices are being used in Texas and Louisiana to reduce, reuse and recycle (R3) drilling waste. In these areas, R3SM technologies and programs can convert drill cuttings to beneficial and environmentally friendly road base and levee fill reuse material to help minimize exploration and production (E&P) operator liability.

Land treatment has been used for years to segregate water, cuttings and oil so that soluble salt content is decreased, oil concentration is reduced by recovery or degradation, and clean cuttings or reuse materials can be separated and stored in secure onsite stockpiles and landfills. What's new about the R3 Process is that converting the reuse material to road base and levee fill can safely transform an otherwise waste material to a reusable product.

Lab tests of the new road base recyclable R3 Product conducted in Texas have proven that it is environmentally sound, more affordable than traditional asphalt paving materials and has comparable engineering qualities. Pending rule changes by the Railroad Commission of Texas to reclassify treated cuttings as reuse material may allow and encourage the industry to safely recycle a drilling waste into a recyclable product. This paper will address the progress in Texas.

INTRODUCTION

Texas is an oil and gas state--has been and will continue to be for decades. The oil and gas exploration and production industry drives the economy providing countless jobs, valuable natural resources, and a tremendous tax base. While the general public reaps the benefits, our industry is also scrutinized as one of the most prevalent polluters because of the large quantities of waste it generates. Wastes such as oil and water based muds and associated cuttings, produced water and sands. Historically, these wastes have been disposed of using varying methods including, land farming, pit disposal, slurry injection, landfilling, thermal treatment, incineration, evaporation and salt cavern disposal (1). While the E&P waste disposal industry is mature and fairly well-defined, and an integral part of the oil and gas business, it for the most part has not evolved as far as technology advancements.

The Railroad Commission of Texas (RRC) encourages the oil and gas industry to minimize waste by following the Waste Management Hierarchy of Preference (2) as follows:

1. source reduction,
2. recycling,
3. treatment, and
4. disposal

For example, during drilling operations, operators seek options to minimize waste generated at the source. One method is the use of mechanical means to separate the undesirable cuttings (waste) so that the drilling fluids may be reused. Once wastes are minimized at the source, the remaining solid wastes, meeting RRC criteria, are treated and disposed onsite (i.e. land application, burial, injected), or transported to a commercial facility for treatment and disposal. Surprising enough, recycling of these waste solids rarely occurs.

E&P waste recycling operations are not new. In fact, companies have been recycling waste since the 1950's. There are recyclers permitted by the Railroad Commission to process waste materials and have had varying degrees of success--mostly for the recovery of oil--because of the recent oil price increases. Oil, a non-renewable resource, is recovered for resale, however, little has been done for the reuse or recycling of the remaining treated solids destined for disposal. The treated waste solids are a non-renewable resource as well, and in prolific oil and gas areas, are generated in substantial volumes. At times, these treated waste solids have been used for levee material, firewalls, pads and road base mostly within the generators' facility. For the most part these treated materials are not reused. Why? Consider the following:

- End users of the recyclable product may require larger volumes than the recycler has access to
- End users of the recyclable product may require stricter engineering product specifications than the recycler can provide or obtain
- Recyclers may lack the experience or the technology to manufacture a properly engineered recyclable product
- Transportation costs of recyclable product may be prohibitive

- Recycling industry has lacked standardized rules
- Recyclable product has lacked regulatory definition
- Generators have been reluctant to recycle E&P waste, as they do not want their name associated with the waste once it has been applied to the ground...the issue--liability.

US Liquids of LA, L.P. (USLL) is an environmental waste management company that treats and disposes of exploration and production waste. USLL owns and operates facilities in Louisiana and Texas with two of those facilities in South Texas. The USLL Rincon (Starr County) and Zapata (Zapata County) facilities have managed waste for over 10 years. Treatment at these facilities includes the separation and recovery of oil for resale and removal of water for disposal. The solids undergo a land treatment process within the cells to degrade remaining hydrocarbons, assisted by disking and tilling. Once the solids are treated to a total petroleum hydrocarbon (TPH) compliance limit of 50,000 ppm, the solids are destined for disposal in onsite landfill cells. Over 400,000 cubic yards of E&P waste materials have been placed in the disposal cells throughout the life of these facilities.

Recently, USLL surveyed the industry, asking key players what they consider the most important issue regarding waste disposal. The answer was obvious. Liability. This paper describes the steps USLL has taken to develop its R3 Initiatives and more specifically what USLL has done to convert E&P waste materials into a recyclable product so that the generators' liability will be minimized or possibly eliminated.

What was once waste in a landfill now has the potential of becoming a repository of aggregate to be mined and used as feedstock for the manufacture of a commercially viable recyclable road base, referred to as the R3 Product.

DEVELOPMENT OF THE R3 TREATMENT

Reduce, Reuse and Recycle

USLL's South Texas facilities receive large volumes of E&P waste, primarily oil based drilling muds and cuttings. To achieve R3, the waste must be **reduced** by properly segregating and separating the waste materials. The oil must be recovered and **reused** and the treated solid waste **recycled** into a product.

Markets

No matter how environmentally conscience or noble the intent of any recycling effort, success cannot be achieved without a viable and continuing market for the end product.

Prior to taking on an endeavor of this magnitude, USLL conducted a market study to understand and define the potential uses of the R3 Product. Market development began with an inventory of USLL materials and of the requirements necessary to move the project forward.

Prospective customers were identified including the state of Texas, counties, cities, oil and gas operators and ranch owners. These potential end users stipulated the following criteria:

- location of product utilization must be relatively near the feedstock repository,
- sustainable quantity of the recyclable product must be available, and
- provide a cost competitive product to what currently exists in the marketplace

The market study also identified that the South Texas area was experiencing a shortage of economical aggregate, an escalation of rock and asphalt prices, a shortage of pozzolon and prohibitive transportation costs; while the area was planning infrastructure growth for the construction and improvements of several thousand miles of roads.

The state of Texas, specifically the TxDOT, was easily determined to be the number one potential end user of the R3 Product. Historically, traditional road base products used in the South Texas TxDOT District are imported from areas as far as Central Texas and Southern Mexico making product transportation cost prohibitive. TxDOT became very interested in the R3 Product once it was learned that it would be manufactured within 25 miles of their District sub-office.

With an inventory of over 400,000 cubic yards of high quality, downhole bedrock aggregate at its South Texas facilities, USLL's objective was to:

- prove the ability to manufacture a product and meet both engineering and environmental specifications
- sustain long term operations
- maintain a low cost operation
- provide a competitive economical product to what currently exists in the marketplace
- commit and comply with the health, safety and environmental regulatory requirements

Proposed Regulations

The Railroad Commission of Texas regulates the treatment and disposal of oil and gas waste, as described and defined in Statewide Rule 8 and 30. It also regulates the recycling of the same waste via minor permits and/or the RRC Surface Waste Management Manual - Application Information for Permit to Treat Oil and Gas Waste for Use as Roadbase (3).

USLL conducted an extensive search at the state level for existing recycling rules. Even though the RRC maintained jurisdiction over E&P waste and had an existing regulatory framework, USLL believed that the rules lacked definition, were not standardized and did not provide direction to one applying for a recycling permit. The

rules certainly did not encourage the generator to recycle its waste. In November 2005 and with the support of the RRC, USLL drafted commercial recycling rules and submitted a petition for rulemaking that USLL believed would provide consistency, uniformity of regulatory criteria and establish clear guidance for those in the E&P recycling business. USLL proposed that the rules be included in Chapter 4 entitled "Environmental Protection (4)." The rules were published in the Texas Register in June 2006 and included a 30-day comment period.

One of the most significant excerpts from the proposed rule is the definition of recyclable product. The proposed rules intend to define "recyclable product" to mean a reusable material that has been created from the treatment and/or processing of oil and gas waste as authorized by a Commission permit and that meets the environmental and engineering standards established by the permit for the intended use as a legitimate commercial product. "**A recyclable product is not a waste**, but may become a waste if it is abandoned or disposed of rather than recycled as authorized by the permit (4)". As of this writing, the rule has not been promulgated, but the intent of the language is that once an E&P waste is recycled into a product, the operator's liability is greatly minimized and essentially eliminated as now the recycler is responsible for the product it manufactures.

In the interim, an operational decision was made by USLL to move forward with a "Road Base" Pilot Project at the USLL Rincon facility and lay the ground work for a full scale recycling operation. To get started, USLL applied for and received a minor permit while concurrently applying for a full commercial recycling permit in addition to its existing commercial disposal permit. The key issues in the minor permit were to 1) protect the environment; and 2) manufacture a product that met engineering and environmental specifications.

In addition to the RRC regulations and requirements, TxDOT has an established program for accepting recyclable products for the use in road construction. This program includes engineering and environmental specifications that must be achieved.

The DMS-11000 (5) governs the process for evaluating the environmental factors associated with nonhazardous recyclable materials (NRMs) not addressed in other TxDOT specifications.

TxDOT's approval criteria for the use of a NRM product is dependent on two factors:

- 1) Engineering – product must meet applicable department engineering specifications and other engineering evaluations deemed necessary by the TxDOT
- 2) Environmental – poses an acceptable level of potential environmental risk, following an evaluation of its environmental characteristics

NRM Product Approval Process:

To be eligible for use on TxDOT projects, the NRM product must:

- meet all applicable department engineering specifications and other engineering evaluations deemed necessary;

- contain only NRMs that meet the standards listed under Item 6, "Control of Materials," Article 6.9, Recyclable Materials of the Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges;
- contain only NRMs that are managed and protected from loss, as would be raw materials, ingredients, or products;
- be used without the need for short-term or long-term management, such as special worker protection precautions, deed restrictions or notices (i.e., institutional control requirements associated with the reuse of contaminated media as discussed in 30 TAC 350.36), tracking, monitoring, special handling after the project life, or special engineering controls;
- not present an increased risk to human health, the environment, or waters in the state when applied to the land or used in products that are applied to the land.

The DMS-11000 provides for an eligibility process. In the process, bench scale recyclable products must be formulated, developed and manufactured and extensive tests performed on those products. The product specified by the TxDOT--Special Specification 3157.

Recyclable Product Development

With the markets established, the regulations identified and the product specified, the recyclable product development began. USLL selected Raba Kistner, an engineering, environmental consulting and construction management company located in San Antonio, to perform bench scale tests. Mix designs were created by experienced, non-biased engineers, which included the comparison of various drilling waste/asphalt mixtures with traditional mix designs. The development goal was to meet engineering specifications, comply with environmental criteria and maximize the use of treated waste material in the final recyclable product. As per USLL's RRC minor permit, the product criteria were as follows:

PARAMETER	LIMITATION
Compressive Strength by Method Tex-126-E	35 psi minimum
Hveem Stability by Method Tex-208-F	35
SPLP by EPA Method 1312	
Metals	
Arsenic	<0.50 mg/l
Barium	<100.00
Cadmium	<1.00
Chromium	<5.00
Lead	<5.00
Mercury	<0.20
Selenium	<1.00
Silver	<5.00
Benzene	<0.50

1:4 Solid: Solution 7 Day Leachate Test (LA 29-B Method)

Chlorides		<700.0
TPH		<100.0
pH	(Standard Units)	6 – 12.49

TxDOT, Special Specification No. 3157 required:

- Minimum requirements for compressive strength shall be 35 psi for secondary roads and 50 psi for primary highways.
- Minimum requirement for Hveem stability shall be a stability value of 35.
- Asphalt content shall be determined according to product specific mix design requirements.

- Gradation,

Sieve Size	Percent
1 3/4 inch	100
No. 4	60* maximum
No. 40	50* maximum

* at the discretion of the Engineer

To meet the above criteria, Raba Kistner proposed a formulation that included a course aggregate, a pozzolon, an asphalt emulsion in addition to the E&P treated waste material or NRM. The aggregate is a native caliche located nearby the repository. The pozzolon consisted of cement kiln dust and commercial asphalt emulsion.

As per the DMS-11000, a recyclable product can be compared to “traditional material being replaced.” The R3 Product was compared in side-by-side engineering and environmental comparisons to materials such as:

- “SS-1h mixture”, a product prepared to TxDOT 3157 (i.e., oil field materials, native caliche, pozzolon and an asphalt emulsion binder). SS-1h is a water based asphalt emulsion containing no VOC or solvents.
- “MC-30 mixture”, a product prepared to TxDOT 3157 (i.e., oil field materials, native caliche, pozzolon and an emulsified asphalt). MC-30 is a “Cut Back” emulsified asphalt, commonly used by TxDOT, which contains a medium weight petroleum hydrocarbon and used as a “Cut Back Solvent.”
- “Type-D mixture”, a hot mix asphalt prepared to TxDOT Type D specifications.

After extensive testing, the laboratory results proved that the bench scale recyclable products met or exceeded the minimum engineering and environmental requirements identified by all regulatory agencies.

Recyclable Product Application

Encouraged by the successful bench scale testing, USLL established a recyclable product launch. With the permits in place and customers established, the program began by sourcing experienced personnel in the management and operations of mixing plants and recycling projects, securing full scale equipment such as a crusher, screens, pugmill, feed bins, radial conveyors, weighting systems, silos, etc.

The setting for the R3 project (the “project”) was at the USLL Rincon facility in Starr County. Over its history, this facility has disposed over 180,000 cubic yards of waste materials into its landfill cells. USLL’s proposal was to incorporate the treated, nonhazardous oil field materials into specified grades of commercially viable asphalt paving products based on TxDOT Special Specification 3157 and Item 345 Modified Cold Mix/Cold Laid Asphalt Stabilized Base Course. USLL utilized the TxDOT DMS-11000 Guidelines to demonstrate that the subject products will meet these criteria and be protective of the environment, public health and the waters of the State of Texas.

Work and QA/QC Plans were drafted as part of the DMS-11000 submittal and internal operation documentation. The USLL QA/QC Plan was designed to document that the NRM Product passes TxDOT defined “acceptable level of potential environmental risk”, and conforms to the DMS-11000 Eligibility Criteria. The QA/QC Plan was designed as a risk management tool and as an in-house check list that provides defensible documentation of the product’s environmental and engineering characteristics. The objective of this plan is for all R3 Product to be warranted to comply, as much as practical, with project specific and overall TxDOT and TRRC requirements.

The NRMs to be excavated from the repositories for use in the R3 Product have data on file indicating that they are nonhazardous in accordance with the RRC analytical requirements of the USLL minor permit. The NRM sampling and testing protocol for the Pilot Project followed the RRC guidelines. Beyond the Pilot Project, the sampling and testing protocols will be amended as prescribed by TxDOT DMS-11000.

USLL emphasized that no R3 Product may be used on-site, or transported off-site, until engineering test data and environmental analytical reports have been received, reviewed and signed off by trained senior USLL staff at the site of production and that any R3 Product transported offsite would be documented on a Bill of Lading.

The Pilot Project is scheduled for the Fall of 2006 and will generate a production volume of 4500 tons. The R3 Product will be utilized on a Starr County road, a TxDOT production lot and for road materials within the USLL Rincon facility. Beyond the Pilot Project, it is intended to explore other potential materials that can be used as aggregates such as recycled asphalt pavement, cutlets, ceramic, and crushed concrete, to name a few.

CONCLUSION

USLL firmly believes that exploration and production waste streams must be handled as a waste first and its solids be treated to an acceptable compliance limit before using it as a feedstock for any application. It is also believed that the regulatory landscape must acknowledge that when a waste is properly recycled into a commercially viable product that the generators’ liability is absolved.

The RRC proposed rule making for commercial recycling is taking E&P generators and the waste industry closer to achieving those goals.

When manufacturing a recyclable product, the environmental and engineering analysis must prove that the product is cost effective, meets or exceeds the engineering requirements of the traditional materials being replaced and is environmentally acceptable, complying with the permits and requirements of all three regulatory agencies, the Railroad Commission of Texas, the Texas Commission on Environmental Quality and the Texas Department of Transportation.

Environmental recycling projects will not succeed without market sustainability. The market demands a quality product. No product, no market. The USLL R3 Process is based on an "Engineering First" principle. By following sound business management procedures, maintaining client relations, working with suppliers and buyers as a team, then recycling oil field waste can be a beneficial path forward to the current waste management practices.

The purpose of the USLL R3 Technology was to develop processes to manufacture engineered and environmentally sound recyclable product from treated exploration and production waste and encourage recycling for use as levee and road base materials. It is believed that the R3 Process meets those goals.

REFERENCES CITED

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4. Railroad Commission of Texas, Chapter 4. Environmental Protection, Subchapter B, Proposed new rules in new Subchapter B, commercial recycling
5. Texas Department of Transportation, Environmental Manual, DMS-11000 Evaluating and Using Nonhazardous Recyclable Materials Guidelines, (August 2004)