DECHLORINATION OF SMALL QUANTITIES OF MIXED WASTE FROM A DOE SITE

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ABSTRACT

Sludge from tank bottoms containing PCB's, radioactivity and hazardous constituents are present in several tanks at one of the National Laboratories. Disposal of the material can proceed if the material is removed from TSCA regulations by decreasing the concentration of the PCB's to ≤2 ppm. On the bench scale, this sludge was treated by the DECHLOR/KGME^{TM} chemical dechlorination process. The levels of PCB's were reduced to below 2 ppm, allowing the material to be managed outside the TSCA regulations. RUST believes that this is the first successful chemical dechlorination of a radioactive, RCRA listed, PCB bearing waste. A pilot scale unit is available to provide on-site treatment of the remaining waste.

Because of the small amounts of waste, treatment costs are high on a per unit volume. As a result of these high costs and other concerns the client is investigating potential non-treatment options of delisting the waste of obtaining a waiver. In the event that this particular waste cannot be delisted or a waiver is not granted, then dechlorination of the waste to remove it from TSCA regulations remains a viable option to allow the material to be disposed.

INTRODUCTION

Sludge from tank bottoms containing PCB's (up to 30 ppm of Aroclor 1254), radioactivity (primarily Cs-137, Sr-90, Co-60 and H-3) and hazardous constituents (mainly 1,1,1-trichloroethane, tetrachloroethane, BETX and high concentrations of lead, chromium and mercury) are present in several tanks at one of the National Laboratories. These tanks are thought to contain filter back-wash waste from clean up of irradiation cells. Disposal of the material can proceed if the material is removed from TSCA regulations by decreasing the concentration of the PCB's to ≤2 ppm.

Dechlorination is a common means to treat PCB's (2-4). RUST REMEDIAL SERVICES INC., has developed and patented (1) a dechlorination process, called DECHLOR-/KGME^{TM}, which involves using a strong nucleophile to remove one or more chlorines from the PCB molecule. The DECHLOR/KGME^{TM} process was successfully applied on the bench scale to the treatment of this Laboratory sludge. RUST believes that this is the first successful chemical dechlorination of a radioactive, RCRA listed, PCB bearing waste. The levels of PCB's were reduced to below 2 ppm, allowing the material to be managed outside the TSCA regulations.

Many steps have been taken to bring this technology to commercialization. However, for this particular site and waste, the client has several concerns about applying this treatment in the field. Both the steps and the concerns be discussed, as well as potential resolutions to those concerns.

The client is currently investigating potential non-treatment options of delisting the waste or of obtaining a waiver. In the event that this particular waste cannot be delisted or a waiver is not granted, then dechlorination of the waste to remove it from TSCA regulations remains a viable option.

STEPS TAKEN TO ESTABLISH THE ACCEPTANCE OF THE TECHNOLOGY

From a technical point of view for a innovative technology to be commercially accepted it should go through the following progression:

1. An innovative technology is conceptualized
2. Bench-scale laboratory experiments are conducted (often on surrogates) to determine if the technology works
3. Additional laboratory studies are conducted to determine under what conditions the treatment works and where optimum conditions occur.
4. Bench-scale treatment is performed on actual waste samples
5. Pilot-scale studies are performed to determine useful scale-up information
6. Full scale treatment is performed

In addition, for optimizing the process and troubleshooting a given application, it is necessary to have a basic understanding of the chemistry and physics of the process.

Often a technology does not progress through all of the above steps. In such instances, since the depth of the understanding of the technology is much more limited, it is more likely that the technology will be improperly applied and that problems will arise.

In general, RUST has done much to further the acceptance of innovative technologies. The Clemson Technical Center was built in 1992. The mission of the CTC is to perform bench and pilot scale treatability studies on hazardous, radioactive and mixed wastes. The facility is licensed to handle hazardous, radioactive and TSCA materials. The CTC performs bench-scale treatment on contaminated samples and demonstrates the potential of full-scale remediation by treating these samples using pilot-scale equipment. The CTC can provide guidance and input into on-going field clean ups. Through the CTC, RUST supports steps 1 through 5 above on TSCA/radioactive/hazardous materials.

Specifically for the DECHLOR/KGME^{TM} process, the following steps have been taken to develop this technology:

- The process was first conceptualized in 1988 by scientists at the Geneva Research Center.
- Initial surrogate studies were quickly performed in the laboratory and results were very encouraging.
- Additional studies followed to determine the important variables in the dechlorination reaction and to compare the behavior of surrogates to PCB's.
- Since 1988, bench scale dechlorination of a wide range of compounds (including various PCB's) have

been studied in the laboratory. Oils and solids have been successfully treated.

- Process variables have been thoroughly studied in the laboratory. These data are supported by pilot-scale studies.
- In 1991, a Pilot scale unit was built and was recently field tested.

Specifically for this laboratory sludge, the DECHLOR/KGME^{TM} process was successfully applied on the bench scale to the treatment of this Laboratory sludge. RUST believes that this is the first successful chemical dechlorination of a radioactive, RCRA listed, PCB bearing waste. The levels of PCB's were reduced to below 2 ppm, allowing the material to be managed outside the TSCA regulations.

HINDRANCES TO THE ACCEPTANCE OF THE TECHNOLOGY

In spite of these many advances and steps, the client had reservations about accepting this technology at this DOE site for this radioactive PCB waste. In particular:

- It was estimated that it would cost about $300,000 to treat approximately 200 gallons of waste. A large part of this cost was due to mobilization and initial pilot scale testing. For treatment of larger quantities of waste, the cost would be expected to drop to around ≤$150/gal.
- The process generated a large amount of secondary waste (3 to 6 times the initial volume).
- The treatability study indicated that the waste could be treated and removed from TSCA regulatory requirements. However, the waste would still regulated as radioactive and hazardous (by characteristic only).
- Although extensive laboratory studies have been performed, the process had not been demonstrated at the pilot scale for radioactive sludges. (a previous site cleanup involved non-radioactive soil and had a clean up criteria of 500 ppm; this site's waste was sludge with a clean up criteria of 2 ppm).
- Communication between all parties involved could have been better. Because of insufficient communication 1) additional sample had to be collected (the solids content of the initial samples were much lower than expected) and 2) toluene was used as a solvent in the laboratory studies. In the field a non-hazardous material like kerosene would need to be used. Although similar results could be expected in the field with other solvents, the client would have preferred that a non-hazardous solvent be used.
- RUST had sketchy information about the site and how the waste was generated. The only criteria given for the treatment study was to meet the 2 ppm PCB level, which RUST was able to do. There were, however, several other items of interest to the client. These should have been addressed up front.

Most of the above items were known by RUST at the beginning of the project. But the client was not aware of them. By communicating them up front, the client will be much more aware of the anticipated outcome of the study. Because they were not clearly communicated, the clients expectations were not met.

Too often in bench scale studies the emphasis is on meeting a specific treatment standard. We were able to do this, but this project indicates that there are many other variables which are typically of interest to the client. These need to be considered and addressed up front if at all possible, so that the client is well aware of the scope of application for a given technology and other items of importance (anticipated waste generation and types of waste, approximate treatment costs, etc.)

This project indicates that there is more to a study than performing well from a technical point of view.

CURRENT STATUS OF THE PROJECT

The bench scale studies were successfully completed and an estimate for on-sight treatment of the waste was provided to the client. Based on the concerns listed above, the client is investigating other alternatives. In particular the client is considering delisting the waste or requesting a waiver from the disposal site to accept the material as is since it is a relatively small volume and the PCB levels are between 2 and 50 ppm.

ADDRESSING THE REMAINING HINDRANCES

To bring the treatment cost down would require 1) bulking of the material with other similar wastes, 2) decreasing the mobilization costs by making the dechlor unit more portable, or 3) locate the dechlor unit at a DOE site and have all applicable waste sent to it (this would eliminate the mobilization costs). None of these options are easily workable.

Although the client views the increased waste generation as a hindrance, it does make disposal possible, and is thus a workable option. This volume could be significantly reduced by optimizing the treatment process. Alternatively, pretreatment may be a possible volume reduction step. The cost to dispose of the increased waste volume after treatment may be insignificant compared to other costs, especially since disposal options are available after the waste is treated. The available options should be studied to determine how significant is the increased waste volume. Cost of managing the waste, transporting, disposal, etc., would need to be considered.

No other treatment options were identified for this uncommon waste composition. So, although the treatment "only" removed the waste from TSCA regulations, it does allow the waste to be disposed of.

Only rarely will the full scale treatment have been previously demonstrated on an identical or similar waste. That, to a large degree, is the purpose of bench and pilot scale studies. This point must be clearly conveyed to the client at the initial discussion phase of considering particular treatment technologies.

CONCLUSIONS

This study of the chemical dechlorination process demonstrates that the PCB compounds in a radioactive waste sludge can be dechlorinated to an extent that yields a non PCB compound. On the bench scale, TSCA-regulated, radioactive and hazardous waste was treated by the DECHLOR/KGME^{TM} chemical dechlorination process. Final PCB concentrations of less than 2 ppm were achieved. At this level the waste would be removed from TSCA regulations. A pilot scale unit is available to provide on-site treatment of the remaining waste.

Because of the small amounts of waste, treatment costs are high on a per unit volume. Similar hindrances would be expected for any other treatment technologies that are applied to small volumes of special waste materials. As a result of these high costs the client is investigating potential non-treatment options of delisting the waste of obtaining a waiver.

In the event that this particular waste cannot be delisted or a waiver is not granted, then dechlorination of the waste to remove it from TSCA regulations remains a viable option to allow the material to be disposed of in the Hanford regulated landfills.

REFERENCES

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