Laser Cleaning of Contaminated Painted Surfaces

**Semi-Annual Report
November 1, 1996 - March 31, 1997**

**By:
Ames A. Grisanti
Robert R. Jensen**

Work Performed Under Contract No.: DE-FC21-94MC31388

For

U.S. Department of Energy
Office of Environmental Management
Office of Technology Development
1000 Independence Avenue
Washington, DC 20585

U.S. Department of Energy
Office of Fossil Energy
Federal Energy Technology Center
Morgantown Site
P.O. Box 880
Morgantown, West Virginia 26507-0880

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By
Energy & Environmental Research Center
University Of North Dakota
P.O. Box 9018
Grand Forks, North Dakota 58202-9018

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ACKNOWLEDGMENT

This semiannual report was prepared with the support of the U.S. Department of Energy (DOE), Federal Energy Technology Center, Cooperative Agreement No. DE-FC21-94MC31388. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of the DOE.

TABLE OF CONTENTS

LIST OF FIGURES	i
INTRODUCTION	1
OBJECTIVES	1
ACCOMPLISHMENTS	2
Task 1 – Decision Tree Development	2
Task 2 – Literature Search for Surface Decontamination Reports	2
Task 3 – Compilation of Database from Literature Data	2
FUTURE WORK	7
REFERENCES	7
LITERATURE DATABASE	Appendix A

LIST OF FIGURES

1 Surface D&D decision tree, Sheet 1	3
2 Surface D&D decision tree, Sheet 2	4
3 Surface D&D decision tree, transportation costs	5
4 Production rate and end point achieved for painted steel plate	6
5 Production rate and end point achieved for painted steel I-beam	6
6 Figure of merit for various surface decontamination techniques applied to painted plate and I-beam	7

LASER CLEANING OF CONTAMINATED PAINTED SURFACES

INTRODUCTION

Surface decontamination of concrete and steel surfaces in nuclear facilities provides cost savings during decommissioning operations by allowing recycling or reuse of concrete and steel structures. Separation of radionuclides and other contamination from the concrete or steel substrates also allows reduction in the volume of hazardous materials during the decontamination and decommissioning (D&D) process, resulting in further cost savings.

Several techniques are available or under development for surface decontamination in nuclear facilities. Each technique has its merits; however, none of them is universally the best choice for all surface decontamination applications. The following are some issues which confront an organization selecting a surface decontamination technique for a particular application:

- Project scale
- Concrete or metal surfaces
- Contamination by radiological and other hazardous materials
- Stage of surface decontamination technology development (e.g., commercial, research and development [R&D])
- Equipment operating costs
- Collection of waste generated by surface decontamination
- Occupational health and safety requirements
- Utilities required for operations
- Real-time control of surface decontamination
- Recycling or reuse of decontaminated substrates
- Waste
 - Characterization
 - Classification
 - Transport
 - Storage
 - Treatment
 - Disposal
- D&D equipment decontamination

Because of the multitude of factors which influence the environmental and economic aspects of selecting a surface decontamination technique, it is difficult to select the best method in a given situation. An objective basis for comparing techniques is needed.

OBJECTIVES

The objective of this project is to develop a software tool for use by personnel who must select a surface decontamination technique. The software will incorporate performance data for available surface decontamination techniques.

The major activities in the project are broken down as follows:

- Task 1 - Complete decision tree development
- Task 2 - Literature search for surface decontamination reports
- Task 3 - Compilation of database from literature data
- Task 4 - Sensitivity analysis and model design
- Task 5 - Design of model data structures
- Task 6 - PC software design and coding

ACCOMPLISHMENTS

Task 1 - Decision Tree Development

A decision tree has been developed which gives the underlying structure for evaluating available surface decontamination techniques for a particular situation. The overall process of surface decontamination is evaluated for a given technology as depicted in Figures 1 and 2. Some of the boxes depicted in Figures 1 and 2 represent flowcharts within themselves, such as those involving waste classification, storage, transport, and treatment. Therefore, flowcharts detailing these areas also have been developed. A flowchart giving details of waste transport costs has been developed and is shown in Figure 3. The flowchart of Figure 3 has been developed using recently available data (1) and allows classification of the transportation mode needed for waste, based on waste type and volume.

Task 2 - Literature Search for Surface Decontamination Reports

A database of available literature on or relating to surface decontamination operations has been completed. All literature in the database is on file in hard copy or microfiche. Initial review of all articles was done to determine the articles which have the most pertinent information for surface decontamination systems analysis. Detailed review and compilation of information from articles is complete. A listing of the literature database is provided in Appendix A.

Task 3 - Compilation of Database from Literature Data

Data on surface decontamination operations are being gleaned from available reports. Several articles (2-9) contain evaluations of surface decontamination techniques for specific cases. Data have been compiled from a number of articles, and an attempt has been made to put the data into a form that will allow comparison. A preliminary analysis of data is presented below.

Figures 4 and 5 show a comparison of production rate and end point achieved for various surface decontamination techniques on painted steel plate and I-beam. The graphs in Figures 4 and 5 have been normalized to the maximum value to allow comparison of production rate and end point. The data in Figures 4-6 have been compiled from work done at Florida International University (3).

Figure 6 shows a comparison of techniques based on a calculated figure of merit. The figure of merit is a normalized sum based on the techniques performance in the areas of capital

Figure 1. Surface D&D decision tree, Sheet 1.

Figure 2. Surface D&D decision tree, Sheet 2.

Figure 3. Surface D&D decision tree, transportation costs.

Figure 4. Production rate and end point achieved for painted steel plate.

Figure 5. Production rate and end point achieved for painted steel I-beam.

Figure 6. Figure of merit for various surface decontamination techniques applied to painted plate and I-beam.

cost, operating cost, production rate (plate and I-beam), and end point (plate and I-beam). The data in Figure 6 do not take into consideration any aspects of waste disposal.

FUTURE WORK

Completion of the decision tree and compilation of literature data will take place in the next quarter. Activities relating to software design and coding and sensitivity analysis will be initiated during the next quarter.

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M97005478

Report Number (14) DOE/MC/31388-- 5780

Publ. Date (11) 199710

Sponsor Code (18) DOE/EM, XF

JC Category (19) UC-2000, DOE/ER

DOE