Final Decision to Certify CEM MARS-X Microwave Heating System
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CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Final Decision to Certify a Hazardous Waste Environmental Technology

The California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) hereby certify the following company's hazardous waste environmental technology:

CEM Corporation MARS-X Microwave Accelerated Reaction System, a Laboratory Technology for the Extraction of Organic Compounds from Solid Matrices

Chapter 412, Section 25200.1.5, Health and Safety Code (enacted by Assembly Bill 2060, l993) authorizes the DTSC to certify the performance of hazardous waste environmental technologies. Hazardous waste environmental technologies are certified pursuant to implementing regulations found in Title 22 of the California Code of Regulations (CCR 22), Chapter 46, Section 68000. Only technologies that are determined not to pose a significant potential hazard to the public health and safety or to the environment when used under specified operating conditions may be certified. Incineration technologies are explicitly excluded from the certification program. The purpose of the certification program is to provide an in-depth, independent review of technologies at the manufacturer's level to facilitate regulatory and end-user acceptance and to promote and foster growth of California's environmental technology industry.

DTSC makes no express or implied warranties as to the performance of the manufacturer's product or equipment. The end-user is solely responsible for complying with the applicable federal, state, and local regulatory requirements. Certification does not limit DTSC's authority to require additional measures for protection of the public health and the environment.

By accepting certification, the manufacturer assumes, for the duration of certification, responsibility for maintaining the quality of the manufactured equipment and materials at a level equal or better than was provided to obtain certification and agrees to be subject to quality monitoring by DTSC as required by the statute under which certification is granted.

DTSC's proposed decision to certify was published in the California Regulatory Notice Register 2000, volume No. 42-Z, pages 1704-1706 on October 20, 2000 and has been subject to public review and comment. Written comments were not received.
An Evaluation Report supporting the Department's decision is available for review at:

California Environmental Protection Agency, Department of Toxic Substances Control, Office of Pollution Prevention and Technology Development, P.O. Box 806, 1101 I street, 12th Floor, Sacramento, CA 95812-0806
Or contact:
Dr. Ruth R. Chang (510) 540-2651
Hazardous Materials Laboratory, 2151 Berkeley Way Room 515, Berkeley, CA 94704-1011

A description of the technology to be certified, the certification statement, and the certification limitations for the technology of the company listed above follows.

CERTIFICATION PROGRAM (AB2060) FOR HAZARDOUS WASTE ENVIRONMENTAL TECHNOLOGIES

TECHNOLOGY CERTIFICATION

Technology:

MARS-X Microwave Accelerated Reaction System, a Laboratory Technology for the Extraction of Organic Compounds from Solid Matrices

Manufacturer:

CEM Corporation, P.O. Box 200, Matthews, NC 28106, Tel. (704) 821- 7015, http://www.*cem*.com

Technology Description

Microwave energy is a non-ionizing radiation that causes heating by migration of ions and rotation of molecules with dipole moments, but does not cause changes in molecular structure. During the sample extraction process, dipole rotation refers to the alignment of polar solvent-sample molecules due to exposure to the electric component of the microwave field. As the electric field decreases, induced disorder is restored which results in thermal energy being released. The technology combines the speed of microwave heating and closed (sealed) vessel technology to achieve elevated temperatures under controlled conditions. When sample-solvent mixtures are exposed to microwave energy at temperatures above the atmospheric boiling point of the solvent, the analyte desorption rate from the sample is significantly increased. The combined effect of high temperature and rapid heating of the extraction solvent in a closed-vessel system increases the extraction efficiency and significantly reduces the extraction time. The system is equipped with an inboard pressure and a temperature control system for regulating sample extraction conditions via magnetron power output control. The Microwave Accelerated Reaction System (MARS-X) is a closed-vessel heating system designed for laboratory use in extracting a wide range of organic materials from solid matrices. The system can be used for the microwave-assisted process without replacing a non-polar solvent with a polar or co-solvent system. The MARS-X can process 14 samples simultaneously; typical extraction times are 15 to 20 minutes per heating cycle. Samples are limited to a maximum size of 20 grams. Solvent systems commonly used in Soxhlet extraction are applicable for the MARS-X system. Solvent volumes are in general 25 to 30 mL per sample. The maximum operating conditions for the system are 200°C and 200psi for GreenChem™ and 140 psi for CleanChem™, with typical operating conditions at 110-135°C and 100 psi.

Certification Statement

Under the authority of Section 25200.1.5 of the California Health and Safety Code, the Department hereby certifies the MARS-X Microwave Accelerated Reaction System manufactured by CEM Corp. Matthews, NC 28106, as a Laboratory Technology for the extraction of semivolatile organic compounds for PAHs, organophosphorus pesticides, organochlorine pesticides, polychlorinated biphenyls, acid, base and neutral compounds and petroleum hydrocarbons in soil, sediments, and sludges.

According to the instrument operating conditions suggested by the manufacturer, the CEM microwave extraction system is capable of achieving an extraction efficiency equivalent to conventional extraction techniques for most target analytes listed as EPA priority pollutants from various solid matrices. There is little evidence of chemical effects or thermo-degradation for most environmental pollutants during the extraction process. The recoveries of microwave extraction can vary due to the properties of the analyte, the presence of interferences, and matrix factors. Consultation with CEM for special-case applications is recommended.

The MARS-X is equipped with safety features to monitor the cavity for the presence of solvent. The detector shuts the system off automatically, if the solvent concentration reaches 1/10 of its lower explosive limit. An alarm will sound and post a message for operators. The operator should operate the microwave unit in accordance with the safety recommendations by CEM.

Limitations of Certification

The Department makes no express or implied warranties as to the performance of the manufacturer's product or equipment. The Department has not conducted any bench or field tests to confirm the manufacturer's performance data. Nor does the Department warrant that the manufacturer's product or equipment is free from any defects in workmanship or material caused by negligence, misuse, accident, or other causes.

The Department believes, however, that the manufacturer's product or equipment can achieve performance levels set out in this Certification. Said belief is based on a review of the data submitted by the manufacturer and other information, and is based on the use of the product in accordance with the manufacturer's specifications.

This certification is subject to the regulations found in Title 22 of the California Code of Regulations (CCR 22), Chapter 46, Section 68000, which include the duration of the Certification, the continued monitoring and oversight requirements, and the procedures for certification amendments and decertification.

By accepting this Certification, the manufacturer assumes for the duration of the Certification, responsibility for maintaining the quality of the manufactured materials and equipment at a level equal or better than was provided to obtain this Certification and agrees to be subject to quality monitoring by the Department as required by the law under which this Certification is granted.

Specific Conditions

CEM shall follow their established quality control and quality assurance program to ensure that the materials used in manufacturing and the quality of the instrument meets standards certified under ISO-9002.

CEM shall maintain their standards for ensuring that users receive applicable training in operation and maintenance of the technology. The quality control procedures for sample extraction specified in U.S. EPA SW-846 Method 3500 must be followed to ensure meeting the project specific requirements. A method blank and surrogate compounds must be included in the operation to validate the instrument performance.

Through updates of user guides, the Manufacturer shall inform the user of interferences and matrix effects that potentially affect the performance of the system, as they become known to the Manufacturer.

Users shall follow the manufacturer's instructions for installation, operation, and maintenance. Users shall develop and follow a plan in accordance with their facility's quality management system for validating the system at appropriate intervals according to the guidance set for the MARS-X system.

Basis for Certification

The certification of this technology is proposed on the bases of the information and data packages pertaining to the performance of MES-1000 (an initial Model of closed -vessel microwave solvent extraction system) and MARS -X submitted by the CEM. These performance data substantiate the following findings: (1) The technology extraction efficiency of the CEM MARS-X is comparable to Soxhlet extraction; (2) The technology provides environmental and economic benefits over the conventional solvent extraction methods; (3) The instrument is tested and approved per OSHA guidelines; (4) The company is certified under ISO-9002 standards; and (5) Satisfactory reports were received from user's survey for the MES-1000 and MARS-X closed-vessel microwave extraction systems and service provided by the company. A listing of the documentation available for this evaluation is contained in the Evaluation Report.

Recommended Applications

The CEM MARS-X microwave accelerated solvent extraction system is intended for the extraction of organic compounds from environmental samples in the laboratory for subsequent analysis using appropriate analytical methods. Applications include extraction of semivolatile organic compounds, including PAHs, chlorinated pesticides, PCBs, organophosphorus pesticides, acid, base, and neutral compounds and total petroleum hydrocarbons from soil, sediments and sludge. The microwave extraction operating in according with conditions established by the manufacturer can serve as a viable alternative for conventional solvent extraction methods.

With the advantages of substantial reduction in the sample extraction time and solvent consumption, the MARS-X technology significantly improves the sample turnaround time for data generation for the protection of public health and the environment.

Regulatory Implications

DTSC's certification does not change the regulatory status of the extraction of organic compounds from solid matrices; it is intended, however, to facilitate and encourage the acceptance of this technology where a project's data quality objectives can be met by its use. To this end, regulatory programs are encouraged to consider the Department's findings regarding this technology, depending on each program's objectives and constraint. State-regulated facilities may contact state permitting officers regarding the use of the technology for sample preparation for organic compounds. Other local and state government permitting authorities may take this certification under consideration when making their permitting decisions. Project managers may consider using this technology where its use can contribute to the project and its data quality objectives.

Duration of Certification

This certification takes effect 30 days after the date of publication of this Notice. Unless amended or revoked for cause, this certification will remain in effect for three years.