Characterization and Pre-treatment of LLW in Turkey - 12572

Ahmet Erdal Osmanlioglu

Çekmece Nuclear Research and Training Centre, Istanbul, Turkey

ABSTRACT

Pre-treatment of radioactive waste is the first step in waste management program that occurs after waste generation from various applications in Turkey. Pre-treatment and characterization practices are carried out in Radioactive Waste Management Unit (RWMU) at Cekmece Nuclear Research and Training Center (CNRTC) in Istanbul. This facility has been assigned to take all low-level radioactive wastes generated by nuclear applications in Turkey. The wastes are generated from research and nuclear applications mainly in medicine, biology, agriculture, quality control in metal processing and construction industries. These wastes are classified as low- level radioactive wastes. Pre-treatment practices cover several steps. In this paper, main steps of pre-treatment and characterization are presented. Basically these are; collection, segregation, chemical adjustment, size reduction and decontamination operations.

INTRODUCTION

After waste generation, basic step of waste management is pre-treatment. Pre-treatment is an initial step to handle radioactive waste for being easy for treatment, conditioning and packaging. It is important to prepare predisposal waste packages for storage and/or disposal. Main objectives of pre-treatment practices in Turkey are presented as follows;

a) Segregation of radioactive waste into active and non-active streams.
b) Separation of active stream into components for further process
c) Converting the waste form into a suitable form for requirements of next WM (treatment, conditioning, storage, off-site transport, final disposal etc.) steps.
d) Recover products for recycling.

In all pre-treatment practices, pre-treatment benefits are taken into account related to radiation exposure (as ALARA) and costs.

Pre-Treatment Methods

Selection of pre-treatment method based on not only characteristics of the waste but also several parameters as well. These parameters are:

1. Radiological protection standards
2. Waste minimization factors
3. Pre-treatment technology
4. Economical factors
5. Requirements for the further treatment,

Expected results of pre-treatment are; improving overall safety, minimization of exposure and decreasing costs in subsequent waste management steps.

Collection and Segregation

Collection involves the receipt of the waste from the waste generating processes. Preferably, basic separation should be done at the generation site. But in any case, conceptual separation is carried out at the RWMU. For this reason, collection is followed by segregation in practical applications. Segregation is a separation activity according to radiological, chemical, biological and/or physical properties. Segregation is the last step for radioactive wastes to facilitate waste handling and/or processing.

The radioactive wastes are segregated physically into two groups at RWMU. These are; liquid wastes and solid wastes. Solid waste is also separated into two groups; non-compactable solid wastes and compactable solid wastes. Non-compactable solid wastes comprise; spent sealed sources, metals, hard parts etc. Compactable solid wastes comprise; gloves, clothes, papers etc.

Different packages are used for collection and segregation of solid waste in Turkey. For segregation at place of origin appropriate containers are used for different waste types. These are;

- Plastic bags are used for compactable waste (Fig 1)
- Containers are used for TENORM for decontamination
- Shielded packages are used for direct immobilization (non compactable waste)

Fig 1. Plastic bags for compactable waste.

Type of containers for waste collection depends on type of waste, storage time and conditions, transportation means and treatment options. Segregation operation is based on several criteria. Determination of these criteria is mainly based on characterization practices. For this reason, characterization step is integrated with segregation. Such as segregation is carried out depending on following properties;

- Physical and chemical characteristics of the waste
- Type and half-life of the radionuclide in the waste
- Concentration of the radionuclide in each waste package
- Specifications or requirements for further processing.

Chemical Adjustment

Chemical adjustment is used as pre-treatment especially for liquid radioactive waste. The most common procedures of chemical adjustment are:

- Acid or alkaline adjustment
- Removal of ammonia by alkaline distillation
- Destruction of oxalates
- Modification the behavior of conditioned waste
- Destruction of organic acids

Size Reduction

Size reduction techniques are used for many reasons. Some of these reasons are; packaging for transportation, increasing storage/disposal capacity, to prepare the solid waste for subsequent treatment etc. Size reduction method also improves efficiency of compaction, chemical degradation, oxidation, etc. Basic application of size reduction is compaction practices in Turkey (Fig 2).

Fig 2. Compactor for compactable waste.

Packaging

Packaging of solid radioactive waste by the waste generator for handling, transportation and further waste processing is an important pre-treatment operation.

Packaging must be complied with national transport regulations, acceptance criteria of RWMU and further waste processing. In all applications general occupational radiation protection standards are taken into account.

Low level solid waste is normally collected at the origin in yellow plastic bags with sheet thickness between 0.1 and 0.2 mm and volumes of 70 L, and marked with the radiation symbol. Non-compactable small size LILW and TENORM are usually collected in metal boxes or drums of 200 L (Fig 3) for small generators and containers of 20 t for big generators.

Fig 3. Waste packages (200 L) in interim storage.

Standard HEPA (high efficiency particulate air) filters are packed in welded plastic bags. Cardboard boxes are used as an over pack.

Decontamination

Decontamination is employed to reduce contamination to levels acceptable for reuse or disposal as non-radioactive waste. Main principle of decontamination is minimization of personnel exposure during subsequent waste treatment operations or for product recovery. Decontamination is carried out only in case of benefits is greater than the cost of the decontamination process. Secondary waste amount and further costs of generated waste from decontamination are other factors. The exposure of operators involved in decontamination operations are also taken into account before decision.
Generally decontamination technique is selected according to properties of the waste. Such as for TENORM and metal scraps, decontamination technique is based on combination of both thermal and chemical surface oxidation of metal at certain depth. Some of these techniques are;

- Manual methods
- Vibratory cleaning;
- Water Jets,
- Machining
- Vacuum cleaning;
- Chemical decontamination
- Electro polishing;
- Ultrasonic methods

Waste Characterization

Waste characterization is important application for every step of waste management program. In addition, initial waste characterization has some extra advantages. Some of them are;

- Requirements of radiation protection measures
- Classification
- Identification for treatment and conditioning
- Selection of techniques
- Record keeping

Radioactive waste is characterized according to its radioactivity, chemical and physical properties. Waste characterization studies in RWMU cover determination of following properties of the waste. Radioactivity properties are; total activity, radionuclide content, radiation stability and contamination. Chemical properties are; chemical stability, chemical composition, flammability, chemical reactivity, corrosive activity, chemical compatibility, explosives, gas generation, toxicity and organics. Physical properties are; physical form, porosity, mechanical strength, size and thermal stability.

Quality Assurance

Initial characterization of waste is important for Quality Assurance program. Quality Assurance program at initial characterization stage includes identification of all parameters important for ensuring that physical, chemical, mechanical, biological and radiological properties of waste are corresponding selected methods of treatment, conditioning and disposal with consideration of all safety requirements.

REFERENCES

1. International Atomic Energy Agency. (1987). Techniques and Practices for Pretreatment of Low and Intermediate Level Solid and Liquid Radioactive Wastes, Vienna, Technical Reports Series No. 272.