

Non-Radioactive Waste Management in a Nuclear Energy Research Institution

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ABSTRACT

For more than 50 years, non-radioactive materials have been used in processes at IPEN to support the nuclear fuel development and all related activities. Reagents, raw materials, products and by-products have been stored. Many of these are hazardous highly toxic or reactants materials. Some years ago actions sent part of these non-radioactive waste materials to proper disposal (technical incineration) resulting in an Institutional Non-Radioactive Waste Management Program. In 2005, an internal set of procedures and information entitled “GUIA DE PROCEDIMENTOS PARA ARMAZENAMENTO, TRATAMENTO E DESCARTE DE RESÍDUOS DE LABORATÓRIO QUÍMICO” (Guide of Procedures for Storage, Treatment, and Disposal of Chemistry Laboratory Wastes” was published to be used at the IPEN’s facilities. A data base managed by software was created in order to allow the Units to input data and information about the routinely generated wastes and those already existing. Even after disposing so huge amount of wastes, a latent demand still exists. Several goals were achieved notably a well-organized and roomy space; safer storage places; local, state, and nationwide laws enforcement (for radioactive and non-radioactive materials); and improvement in chemicals control as hazardous and aged materials are more frequently disposed. A special stress was conducted to know and follow laws, regulations, and technical norms as the entire process is very detailed and this is not a day-by-day routine for the IPEN’s technical personnel. The immediate consequence is that the safer the workplace the safer the nuclear related activities are done.

1. INTRODUCTION

Almost all activities developed and run at IPEN generate chemical waste. These activities are not exclusively related to nuclear materials or compounds. Areas such as environmental science, lasers, engineering materials, biology, and even the most routinely tasks as maintenance produce quantities of chemical wastes. This paper is intended to report only non-radioactive waste actions. More than 50 years of activities have produced a huge quantity of wastes. These chemical wastes are different in nature and quantities. Acids, bases, raw materials, by products, chemical analyses samples, contaminated reagents, and unknown materials are some examples of what was storage for disposal. According to the internal activities division, these materials were stored in different places during different periods. Some of them were essentially placed and forgotten in such areas until an action was run.

After have been manipulated and stored for a long period, labels and even the flasks were not in the initial conditions. Paper labels are prone to disintegrate or the imprinted information erased and lost. There were some steel cans in degraded conditions. Paper bags and packs were also found in poor conditions. Well preserved flasks but disintegrated caps. All these examples and much more were frequently found in the storage places. Some items were

found in dangerous conditions exposing hazardous contents. In the Fig. 1, some of these examples can be seen.



Figure 1: Examples of packs conditions after long period of storage.

The Fig.1 examples were not the rule. Although some critical cases, most of materials were properly stored and labels, flasks, and packs were in good conditions even after years. Fortunately, no accidents or injuries were reported due these poor conditions.

One main concern was the local storage conditions. Some places were clearly not suited to store these materials or were overloaded.

Quantities were also an issue. Some materials were stored as few as some grams others in hundreds of kilograms. Frequently, the container was heavier than the content but the whole mass had to be considered to be charged.

No action could be carried out without consider personnel and environmental safety, the laws, technical standards and the destination. In this way, the Brazilian Resolução CONAMA no.

357/2005 [1] and the updates, the Portaria do Ministério da Saúde no. 2914/2011 [2], the ABNT 10004/2004 [3] standard were some of the references used when dealing with chemical wastes.

Incineration is and was the first choice for the waste destination. If properly executed, incineration is fast, secure and reliable for human health and any future environmental impact.

2. DEVELOPMENT

2.1. Chemical Waste Disposal Campaigns

In the beginning, the disposal campaigns were conducted by individual Centers (IPEN is organized by Centers according to characteristic knowledge areas) with no necessary connection between these campaigns. Although obtaining good results, after some campaigns an institutional coordinated action was considered to be the way to get better results. In this way, a Program dealing with chemical wastes was initiated to manage the entire chemical waste generation, storage, maintenance, and disposal.

2.3. Program of Management of Non-Radioactive Chemical Waste

This Program intends to state the basics and procedures of the chemical waste and effluent emission of non-radioactive materials. Several actions are proposed in order to minimize, classify, segregate, store, collect, treat (locally), report, and dispose the useless materials. As a necessary part of the process, legal references are pinpointed to help the participants.

2.4. Technical Support and a Guide for Users

Users can be experts in a specific science subject, but not necessarily experts in waste disposal. Support training was offered to standardize procedures and materials. Labeling is a big issue and is stressed to follow the ABNT NBR 16725 [4] standard. Specific needs or unusual materials have been a challenge. Sometimes, external experts are asked to give a help.

A guide with standard and/or general procedures for storing, treatment, and disposal of chemical laboratory wastes (GUIA DE PROCEDIMENTOS PARA ARMAZENAMENTO, TRATAMENTO E DESCARTE DE RESÍDUOS DE LABORATÓRIO QUÍMICO) [5] was produced and made available to all who wants some additional information.

2.5. Software for Data Base and Control

A software for data collecting, organizing, and control was produced. This software is accessed only by Intranet and allows users to search for a specific material in any area of the institution. As a consequence, a useless material (out of date reagent cannot be used in some applications) can be useful in other less restricted application. Internal donation or exchanges are permitted and, sometimes, encouraged to lower the wastes quantities.

The software allows users to entry the data from each area using a predefined form. As the materials can be still in using, editing is permitted after the initial feeding. Fig.2 is an example of short information that can be retrieved. If needed, another window can be opened to see more details.

The screenshot shows the 'Intranet' interface for the 'BANCO DE RESÍDUOS, SUBPRODUTOS E REAGENTES QUÍMICOS'. The interface includes a search bar, a sidebar with navigation options like 'Objetivo', 'Cadastramento', 'Banco de Resíduos', 'Bolsa de Reagentes', 'Legislação Ambiental', and 'Relatório', and a main table listing chemical substances.

Legenda :	Alterar os dados	Visualizar todas as informações	Apagar os dados	Material enviado para destinação final
	Descrição		Centro	Quantidade
	ACETATO DE AMILA		CLA	1 Litro
	ACETATO DE AMONIO		DIRF	1,0 kg
	ACETATO DE CELULOSE		CQMA	1 kg
	ACETATO DE CHUMBO		CQMA	2,5 kg
	ACETATO DE SODIO		CQMA	1,5 kg
	ACETATO DE SODIO		DIRF	0,5 kg

Figure 2: An excerpt from the software used to collect, organize, and control the materials to be sent for disposal.

2.6. Legal References

This text is not intended to present all legal references. However, anyone in Brazil who is disposing chemical wastes has to consider a profound search in such following institutions: Federal, State and Local laws, Army, National Police (Polícia Federal), Transportation Agencies (Agência Nacional de Transportes Terrestres, ANTT, for example), National and State Environmental Agencies (CETESB, in São Paulo, for example), and technical standards (ABNT). There are several criteria that have to be attended during them process. This means that even internal or external actions/processes are under some regulation.

The city of São Paulo has specific and always updated regulation for terrestrial transportation of chemical wastes. Some substances and/or quantities are allowed to be transported within a defined ring road only in a restricted period of the day. Exceptions have to follow individual approval and procedures.

In São Paulo, a specific document (Certificado de Movimentação de Resíduos de Interesse Ambiental, CADRI) [6] is required by the environmental agency Companhia Ambiental do Estado de São Paulo, CETESB, in order to sent any material or quantity for disposal. This document is specific to the related nature and quantities.

Safety rules that have to be attended are defined by ANTT [7] and in technical standards by ABNT.

The suite of documents including proper transportation documents can be considered as the environmental agency (CETESB) is aware of process and knows, for example, what is or what will be the path to the treatment plant, including predefined stops.

2.7. Materials and Substances

As the nature of the processes run at IPEN, materials and substances are diverse. Materials sent to disposal are even by products, contaminated materials or out of date reagents. It is difficult to say what are all the reasons for disposal. Sometimes the reason is simply the need for some space in the workbench, sometimes is the excessive buy. As these reasons are identified, some of them are improved to lower the quantities.

Common examples are: acids, bases, salts, oxides, remaining analyses solutions, old raw materials, contaminated solutions or flasks contents, and so on.

Examples of diversity of containers are shown in Fig. 3.



Figure 3: Materials diversity. Different containers were used to according to the content/substance.

Small containers as bottles, packs, and boxes were put into intermediate containers as shown in Fig. 4. Chemical compatibilities were checked beforehand (segregation) even to obey securities statements as to attend legal rules.



Figure 4: Intermediate containers (right side) for small containers (left side), e.g. bottles, boxes, and packs.

2.8. Quantities

Since 2002, almost 19.000 kg of chemical waste were sent do proper disposal. In Table 1, the quantities are indicated by year. Consider container and content as the mass reported.

Table 1: Quantities of chemical wastes sent do disposal.

Year	2002	2008	2009	2011	2012
Mass, kg	3540 ^a	2650 ^a	3400 ^b	2900 ^b	6240 ^b

- a. Refers to a one area only.
- b. Refers to whole institution.

There is an expectation of more 5.000kg for the next 4 campaigns to be run no longer than 4-5 years. After that, the routine procedures are expected to generate 500-1000kg of chemical waste per year as the old materials (large quantities) has already been sent to disposal. Although some processes had been discontinued, others were incorporated such as new chemical analyses based on liquid chromatography as demanding by environmental studies. These analyses are known to generate high volumes of wastes.

2.9. Unknown Materials

After many years, some materials lost the labels and any identification. The approach in these cases is: (a) send the material to be analyzed in our laboratories, (b) interview anyone who know about the material or the possible history of the material or (c) send the material to be

analyzed in an external laboratory. The last possibility is too cost for the process. No unknown material can be sent to disposal.

2.10. Radiation Protection Service

The institution has a radiation protection service that attends the internal demand in several situations. These campaigns are one of these situations. All materials are inspected by the radiation protection service before sent to disposal. This means that pack by pack all containers are inspected beforehand. The technical standards used are stated by Comissão Nacional de Energia Nuclear, CNEN [8,9].

2.11. Transportation and Proper Disposal

Transportation is regulated by national and local laws. Even after compatibilities are solved, some materials can be transported only after the authorization of Army or National Police. So, in large list of materials as were usual in all campaigns, double checking prevents any error when sending the materials. The path from the origin to the destination has to be informed, including every road and predefined stop.

Incineration was applied to all wastes. Every campaign had a decision step of what would be the best final treatment for the materials. Despite the lack of many possibilities, incineration and disposal of the ashes in a sanitary landfill was always the choice. The reasons were safety (obeying the legal rules), low cost and low time consuming.

3. CONCLUSIONS

Despite the quantities of non-radioactive chemical waste, IPEN has initiated a series of campaigns to properly disposal these materials. In more than 10 years of campaigns, the quantities of chemical wastes have decreased to a comfortable scenario and are managed safely. During this period, almost 19.000kg of chemical waste (container and content) were effectively destroyed. The expectation is for more 5.000kg for the next 4 campaigns and a regular need of 500-1.000kg per year after that. Organizing the information (Program of Management of Non-Radioactive Chemical Waste) for the whole institution was essential to the reach success of the process. The maintenance of this Program is a challenge as the diversity and dynamics of the institution lead to new demands every year. The attendance of legal rules is also challenging as new or different materials have to be properly disposed when demanded. Optimizing and updating the processes, less waste is been generated. Attention to the Army and National Police requirements has to be stressed all times. One of the major goal is the safety sensation in the workplace. This can be seen as users are frequently saying that the wastes were an uncomfortable presence in the workplace.

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