Proposal for NORM treatment and final disposal in Brazil

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INTRODUCTION

Currently, there is a great concern about the interference of scale and oily sludge accumulated during the operation of oil & gas industry. Disposal of solid waste or produced water containing NORM, when done in an uncontrolled manner, may cause contamination of soil or groundwater [1]. In some countries, O&G companies adopt legally permitted practices that address the disposal of such material, such as injection into salt caves or disposal at sea, for example. In Brazil, no such practice is currently allowed by the regulatory agency (CNEN). There are two types of matter in NORM waste: oily (organic) and radioactive substances (inorganic). And, although both materials present severe pollutants, the solutions found for the disposal of each of them are incompatible: the organic matter has the incineration as final destination recommended; and the inorganic matter - which actually contains the radioactive compounds - is destined to a final deposit of CNEN (National Commission of Nuclear Energy - Brazil). However, currently there is no proper physical space to store all the demand for radioactive waste from the Oil and Gas segment and, in this case, the barrels containing radioactive waste with activity concentrations substantially higher than the limit established by CNEN NN 8.01 are stored on the platforms or FPSOs, generating an unsolvable problem. In view of this technological impasse and seeking a solution that meets the Brazilian demand, it is evaluated the viability of a new and innovative treatment that meets the environmental, social and commercial needs of any country, solving, definitively and safely, the final disposal of wastes containing NORM.

OBJECTIVE

To suggest an industrial process as alternative to the problem of NORM waste disposal, in Brazil and worldwide.

MATERIALS AND METHODS

In order to obtain confirmation that the radioactive elements remain in the inorganic part of the analyzed material, laboratory tests were performed before and after the industrial process suggested in this study. For the radiochemical analysis of the activity concentrations of Ra-226 and Ra-228 elements, 8 samples of oily sludge from wells with different characteristics from two companies with different extraction processes were obtained. The first sample was named ALPAR (N=4) and the second sample named LB (N=4). The investigation of the first sample consisted of radiochemical analysis of the ALPAR sample in two situations: 2 crude oil samples (ALPAR-105) and 2 samples submitted to incineration at 500 °C (ALPAR-104). The second investigation consisted of radiochemical analysis of the LB-983 (N=2) and LB-984 (N=2) samples, which were under the following conditions: the LB-983 sample was in the raw state while the LB-984 sample has been submitted to incineration at 500 °C. Both investigations used the non-destructive Gamma Spectrometry method for elements Ra-226 and Ra-228 to determine the activity concentration. In the industrial process, the material stored in plastic liners arrives in carts that transport the metal drums with this content. The drums are homogenized and a sample is collected in order to characterize each batch. After sampling, the drums proceed to a holding area. The developed technology can be divided into steps, as shown below.

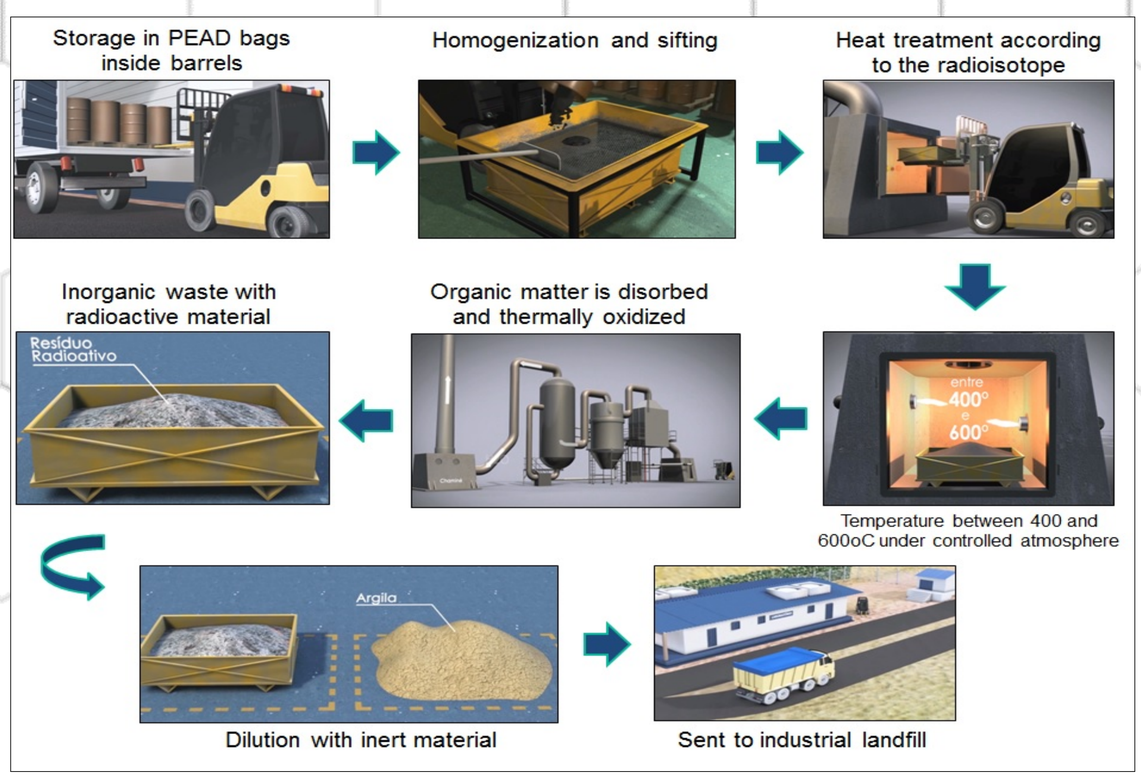

Figure 1. Industrial Process Scheme.

RESULTS AND DISCUSSION

The mean activity concentrations found for Ra-226 and Ra-228 are presented in table 1. The increase in concentration in samples submitted to the industrial treatment suggests that the radionuclides are not eliminated with the organic part, remaining concentrated in the inorganic matter.

Table 1: Activity concentration for Ra-226 and Ra-228 in the analyzed samples

Samples	N		Radionuclides (kBq kg^{-1}) 226 Ra	228 Ra
ALPAR 104 (treated)	2	Mean ± SD	4.804 ± 0.156	2.659 ± 0.94
ALPAR 105 (crude)	2	Mean ± SD	3.739 ± 0.122	2.036 ± 0.074
LB-983 (crude)	2	Mean ± SD	0.135 ± 0.0006	0.159 ± 0.001
LB-984 (treated)	2	Mean ± SD	0.209 ± 0.0009	0.249 ± 0.0009

Finally, through the activity concentration found, the amount of inert material (clay) to be added to the inorganic matter for landfill is determined. In order to make this disposal possible, the dilution must reach the permitted limit for activity concentration that, according to the Brazilian legislation [2], is 10 kBq kg^{-1} for dispensing of materials ≤ 1,000 kg and 1 kBq kg^{-1}, for dispensing of materials > 1,000 kg. Figure 2 shows the results found compared to the limits established by CNEN.

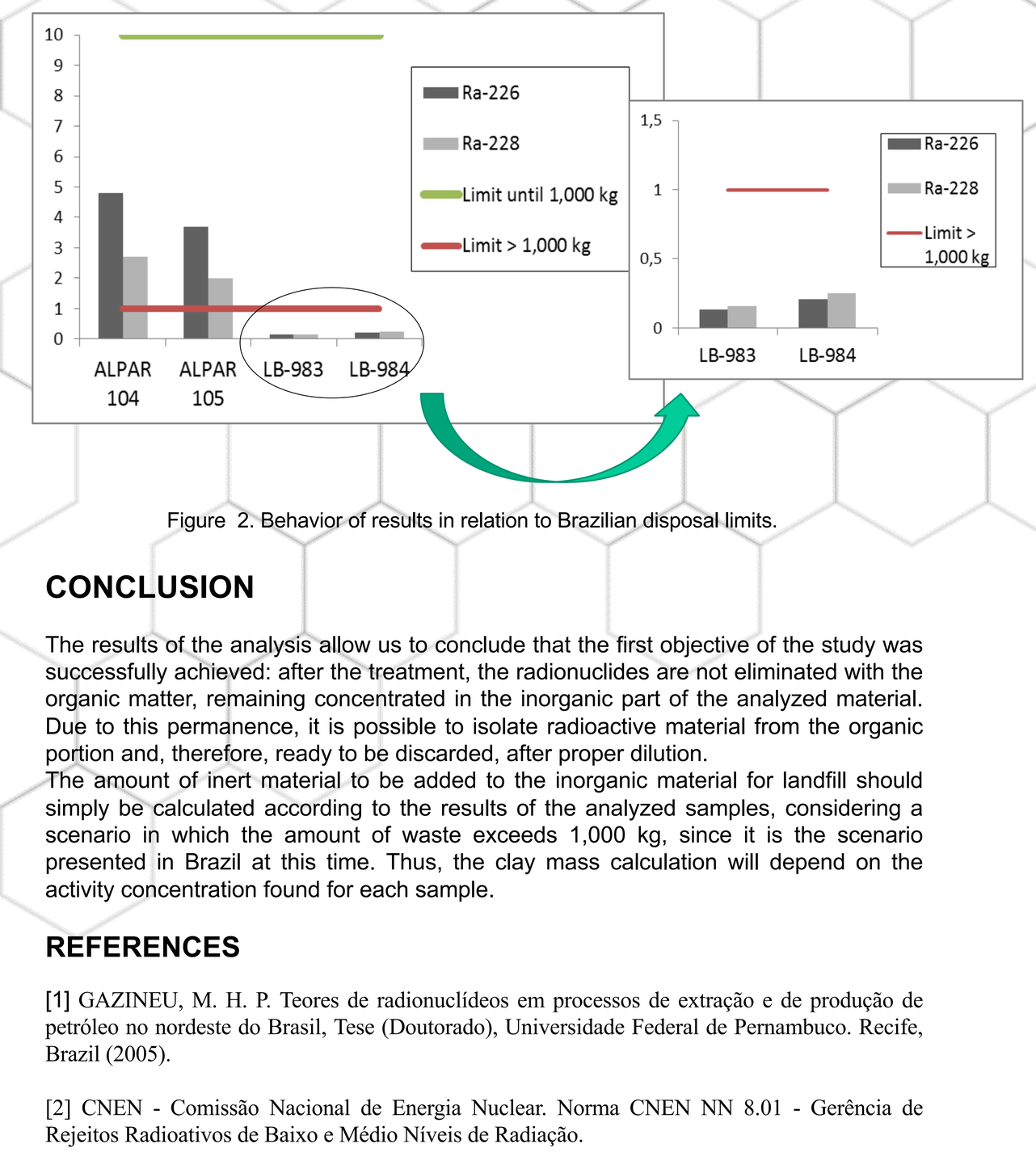

Figure 2. Behavior of results in relation to Brazilian disposal limits.

CONCLUSION

The results of the analysis allow us to conclude that the first objective of the study was successfully achieved: after the treatment, the radionuclides are not eliminated with the organic matter, remaining concentrated in the inorganic part of the analyzed material. Due to this permanence, it is possible to isolate radioactive material from the organic portion and, therefore, ready to be discarded, after proper dilution.
The amount of inert material to be added to the inorganic material for landfill should simply be calculated according to the results of the analyzed samples, considering a scenario in which the amount of waste exceeds 1,000 kg, since it is the scenario presented in Brazil at this time. Thus, the clay mass calculation will depend on the activity concentration found for each sample.

REFERENCES

[1] GAZINEU, M. H. P. Teores de radionuclídeos em processos de extração e de produção de petróleo no nordeste do Brasil, Tese (Doutorado), Universidade Federal de Pernambuco. Recife, Brazil (2005).

[2] CNEN - Comissão Nacional de Energia Nuclear. Norma CNEN NN 8.01 - Gerência de Rejeitos Radioativos de Baixo e Médio Níveis de Radiação.