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USE OF BRAZILIAN CLAYS ON THE RETENTION OF CONTAMINANTS

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1. INTRODUCTION

All human activities produce wastes. Some of them are hazardous due to the concentration of toxic elements and they should not be released without previous treatment. Therefore the main objective in the management of these wastes is to dispose them in such way that the risks remain as low as reasonably possible.

Besides disposal, the waste management includes collection, treatment, conditioning, transport and storage. Different waste management strategies can be adopted concerning to technological processes, storage time and disposal options.

To have a safe disposal all the management steps should be considered from the waste characteristics till the repository shutdown. But it is important to have in mind that a repository for radioactive wastes will not contain all the radioactivity indefinitely. Therefore the repository function is to minimize the risk to the environment for the lifetime of the hazard. This is achieved by ensuring that the waste product can be safely transferred to the repository and by adopting a multibarrier concept.

The immobilization process consists in the conversion of wastes to solid forms that reduces the potential for migration or dispersion of contaminants from the wastes by natural means during storage, transport and disposal.

The cementation is one of the useful techniques to immobilize hazardous and radioactive wastes using cement as matrix material. The relative simplicity of handling, the extensive experience in civil engineering operations, the availability of raw material, the relative low cost, the compatibility with water and the high density and the mechanical strength of cement products are the main advantages for using this material. In addition the process is simple, cheap and efficient.

The cemented waste product should have some properties to assure its handling, storage and disposal. Important properties are leaching resistance, long-term chemical stability, mechanical stability and compatibility with the packaging. Low leachability is generally considered one of the most important properties in the evaluation of an immobilized waste form since it represents the first barrier to the release of radionuclides to the environment over long periods.

Due to the complexity of the water/cement chemistry and its sensitivity to the physicochemical characteristics of the waste, the use additives can improve the waste-cement compatibility and the specific properties of the waste product. Besides some contaminants are very soluble and not interact chemical or

physically with the cement matrix, then it is necessary to add some materials to increase their retention in the final product. Clays are natural cheap materials, which have good sorption characteristics and due to that they can be used as additive in the cementation process to improve the quality of the final product.

In Brazil there are different types of natural minerals and clays are produced and industrialized overall in the country. Researches are being undertaken to evaluate the use of national clays to retain contaminants in the cemented waste product.

The present paper describes the studies of some clays as additive in the waste cementation.

2. EXPERIMENTAL

A survey was made in order to obtain informations about the Brazilian clay properties and production. Bentonite, vermiculite, kaolinite, serpentine and others were tested by adding them to the waste-cement mixture. The properties of the paste and the solid product were evaluated. Radioactive and industrial wastes were solidified.[1,2,3,4,5]

Experiments were performed with wastes from petroleum industry containing basically heavy metals and with active and inactive wastes , which the main contaminant investigated was the cesium

Several tests were carried out with the paste and with the solid product to evaluate the compressive strength, the setting time, the viscosity, the temperature development during the setting, the leaching resistance and the cesium sorption.

3. RESULTS AND DISCUSSION

From the experiments it was observed that cementation is suitable for all the wastes and the products are homogeneous, with good compressive strength and leaching resistance. The limitation was the incorporated amount of the wastes. In cases of very low compatibility between cement and waste some chemical additives can be used to make the cementation process more efficient.

For wastes from oil industry the clays improve the retention of the heavy metals. In Table 1 are presented some results obtained from the cementation of these wastes with serpentine. The leach tests for these products are carried out in full and crushed samples. Also here the retention was more than 99%, and the leached amounts were lower than those recommended by the environmental standards.[3, 6, 7]

TABLE 1: CONTAMINANT CONCENTRATIONS IN THE LEACHANT BEFORE AND AFTER THE WASTE CEMENTATION (Leaching Test)[3,7]

CONTAMINANT	CONCENTRATION (mg/l)			
	INICIAL WASTE	CEMENTED WASTE		MAXIMUM RECOMMENDED
		MONOLITE	CRUSHED	
Cd	3.03	<0.1	<0.1	0.5
Pb	7.07	<0.4	<0.4	5.O
Cr	15.15	<0.3	<0.3	0.5
Cu	2.02	<0.1	<0.1	0.2
Ni	5.05	<0.2	<0.2	0.25
Zn	20.20	<0.1	<0.1	1.8
Fe	878.79	<0.2	<0.2	3.0
Ba	5050.00	<3.0	<3.0	100.0

For the radioactive wastes the use of bentonite and vermiculite reduced greatly the release of cesium without jeopardizing other product properties. For cesium strontium and cobalt the bentonites were very efficient. The retention were up to 99% in the product.

Some leach test results for Cs-137 are shown in Table 2. The samples of cemented wastes with different bentonites were leached in deionized water. There are samples from inactive test that are still being leached for about 9 years, they are undamaged and the leach rate is constant.

TABLE 2: ^{137}Cs RELEASE FRACTIONS AFTER 300 DAYS LEACH TEST(Room Temperature, Deionized Water)[2]

BENTONITE	PERCENTAGE OF BENTONITE ADDED	RELEASE FRACTION $[(A_n) / A_0]^*$
-	0	0.58
G	7	0.03
	15	0.01
F	7	0.05
	10	0.03
B	7	0.08
	15	0.02

* A_n= Total cesium activity released after 300 days
A_0= Cesium activity initially present in the sample

4. CONCLUSION

The incorporation of wastes, liquid or sludge, in cement is a good process to avoid the contaminants release to the environment. A product with good chemical and physical stability can be obtained to assure its handling, transport, storage and disposal without risks for the men and the environment.

Clays are used as additive in order to improve the retention of the contaminants in the cemented product because of their good sorption characteristics. Here in Brazil they are cheap and abundant material.

Products of wastes incorporated in cement and clay are leached using deionized water and acetic acid as leachant. Good results have been obtained and the retention was 99% for cesium (radioactive waste) and up 99% for iron, copper, cadmium and nickel (oil industry waste).

These results show that the use of clays can improve the safety of the waste disposal increasing the efficiency of the first barrier to the release of the contaminants, reducing the further costs.

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