Disposal of Cobalt-60 and Iodine-131 Production Liquid Wastes by the Adsorption of Soil Wastes of Coal Ball

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A simple method of treating cobalt-60 and iodine-131 production liquid waste can be disposed completely after alkalized by sodium hydroxide and then run through the soil wastes of coal ball column; while the iodine-131 production liquid waste can be disposed completely after reduced by sodium bisulfite, alkalized by sodium hydroxide and finally run through the soil wastes of coal ball column. The present method is better than the adsorption method through soils, for the liquid wastes can go through the soil wastes of coal ball more freely. The decontamination factor of this method is very high. Under the experimental conditions, one hundred grams of the soil wastes of coal can be used to dispose more than 15 liters of cobalt-60 liquid waste and 10 liters of iodine-131 production liquid waste respectively.

Introduction

The coal ball is one of the most popular kinds of fuel used in Taiwan. It is made by balling the coal powder with mud. After the coal ball is used and completely burned, the soil waste is disposed as trash.

In our RI laboratory, the iodine-131 is produced by using telluric acid as irradiated target and the adsorption method is used for the separation of radioiodine from the target material. The residual solution is the iodine-131 production liquid waste. The cobalt-60 liquid waste mainly comes from the iron-59 production.

These two liquid wastes can be disposed by the coprecipitation method and the recovery method which has been reported by authors previously. Because of the stickticity of the soil, this method can not be used in large scale. Dr. Gaida has suggested mixing diatom earth with soil to increase the flowing rate of liquid wastes through soil, but this method is still not a good one, for diatom earth is very hard to obtain and the treatment is very complicated.

The soil waste of the coal ball has very low stickticity, the liquid wastes can be flowed through it very freely. In the present work, we have obtained a hundred percent decontamination factor for the disposal of cobalt-60 and iodine-131 production liquid wastes by running the liquid wastes through the soil waste column.

Experimental

I. The Soil Waste of the Coal Ball.

The soil waste of a completely burned coal ball was pressed into fine powders and divided into different meshes by standard screen.

II. The Cobalt-60 Waste

Three grams of cobalt wire was placed in a irradiated basket of the THOR for 360 hours irradiation at a thermal neutron
flux of $4.4 \times 10^{12}$ n/cm$^2$/sec. After one month cooling, the irradiated target was dissolved in 5ml. of 6 N hydrochloric acid, the solution was run through a cation resin column, and washed with 5ml. of 6 N HCl. The cobalt-60 waste was collected in a waste bottle directly.

III. Iodine-131 Production Waste

One hundred and fifty grams of telluric acid was irradiated at a thermal neutron flux of $5.1 \times 10^{12}$ n/cm$^2$/sec for 30 hours. The irradiated target was dissolved in 400 ml. 1 N sulfuric acid and iodine-131 was adsorbed by a platinum foil. The residual solution is the iodine-131 production waste.

IV Adsorption Procedure:

1. The cobalt-60 liquid waste (Activity is 229,392 cpm/ml.) was alkalized to optimal pH (pH 8) with saturated sodium hydroxide solution, the resulting suspension was run through a column (5x15cm) of soil waste of coal ball (100-200 mesh) at a flowing rate of 5ml./min.

2. The iodine-131 production liquid waste (Activity is 383,204 cpm/ml.) was added with saturated barium chloride solution for removing the sulfate ion in the waste. The resulting suspension was then made to 3 N HCl solution by adding concentrated hydrochloric acid. Solid sodium bisulfite was added for reducing the radioactive telluric acid to tellurium, alkalized to optimal pH (pH 12.5) with saturated sodium hydroxide solution. The resulting suspension was run through a column (4x15cm) of soil waste of coal ball (100-200 mesh). One ml. of waste and of the eluate were counted in a well type NaI crystal scintillation counter separately. The decontamination factor was obtained by the following equation.

Decontamination Factor (%) = \( \frac{\text{cpm of waste} - \text{cpm of eluate}}{\text{cpm of waste}} \times 100 \)

V. pH Value and Decontamination

Brown, Parker and Smith$^{(1)}$ and McHenry$^{(11)}$ have reported that the pH value will affect the adsorption of radioactive elements by using of soil as an adsorber.

The wastes were adjusted to various pH value by saturated sodium hydroxide, the resulting solutions were then run through the separated soil waste of coal ball column.

Results and Discussion

The pH value of the liquid can affect the decontamination factor. The optimum pH for decontamination iodine-131 production liquid waste by adsorption of the soil waste of coal ball is 12.5, that for cobalt-60 waste is 8.

The soil analysis of the soil waste of the coal ball shows the cation exchange capacity is 2.09meq/100g. The texture is sandy loam; sand 40%, silt 52% and clay 8%.

Although the cation exchange capacity of the soil waste of the coal ball is lower than that of original mud (10.56meq/100g.), for its low stickticity, it is still a good adsorber for disposal of radioactive liquid wastes. According to the present work, at the optimum pH, 100g. of the soil waste of coal ball can be used for disposing more than 10 liters of the iodine-131 production liquid waste, or more than 15 liters of the cobalt-60 liquid waste, or more than 15 liters of the cobalt-60 liquid waste can be completely disposed by 100g. of the soil waste.

References

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