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THE UNIVERSITY OF ROCHESTER

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10372

INTRAMURAL CORRESPONDENCE

September 25, 1947

Memo to: Dr. A. H. Dowdy
From: Dr. H. E. Stokinger
Re: Trip Report - Maywood Chemical Works

A trip was made Wednesday, August 24th with Messrs. Robert Wilson and George Sprague to the Maywood Chemical Works, Maywood, New Jersey one of 2 plants in the U.S.A. engaged in the production of thorium compounds. The purpose of the trip was to:

1. Learn the type of chemical processes employed in the thorium industry (thorium nitrate).
2. Survey conditions of exposure of personnel associated with these chemical processes.
3. Obtain samples of atmospheric contaminants in the plant, as well as samples of products of the plant.

Plant Operations. The processes involved in obtaining thorium nitrate, purely chemical in nature, start with the mineral monazite, which is treated by alternate solution and precipitation through the sulfate, oxalate, and hydroxide to form a final, relatively pure product of thorium nitrate containing approximately 4 mols of water. (Pure crystalline thorium nitrate has the formula $Th(NO_3)_4 \cdot 12H_2O$, is a hygroscopic solid, requires special conditions for its preparation, and is not obtained in the commercial process.) Figure 1 shows the steps involved in the production of thorium nitrate in the Maywood Chemical Works. It is seen that all operations are performed wet, thus eliminating almost entirely a dust exposure hazard.

Monazite sand is at present derived from India which supplies an ore with the richest content of thorium. It is superior to that of Brazil and far superior to that obtained from North Carolina. It is primarily a phosphate sand containing:

9%	ThO_2
60%	Rare earth oxides (R.E.O.)
0.5%	Uranium oxides

The remainder is silicate. The rare earth oxides are in turn composed of:

50%	Cerium oxide
20%	Lanthanum oxide
20%	Neodymium

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The remaining 10% of R.E.O. is composed of praseodymium, samarium, yttrium, gadolinium, ytterbium, europium. The monazite sand is almost completely soluble in sulphuric acid, 2% only comprising the insoluble residue. An important step in the procedure consists of the precipitation of the thorium as the oxalate along with those of the rare earths. This operation depends upon the fact that all other metal oxalates are soluble in dilute acid with the exception of the above named materials.

A time-consuming step in the process is the repetition of alternate solution in acid and precipitation with ammonia of the nearly purified thorium. It would appear worthwhile to investigate the possibility of electrolytic separation of the impurities to avoid this cumbersome process. At the present time, the product of granular thorium nitrate amounts to approximately 100 pounds per day. This commercial product contains 48% ThO_2.

Uses. At the present time, thorium nitrate is the chief compound of thorium manufactured for industry. The most common are for gas mantles, thorium crucibles (ThO_2), and other uses for the Atomic Energy Commission. The nitrate is the form which is prepared for marketing. The chloride, the oxalate, the citrate, the carbonate, and the acetate have been prepared for certain special uses on request. The present cost of thorium salt is $7.00 per pound.

Industrial Hygiene Aspects. The present process outlined in Figure 1 has but two operations from which workers could receive exposure to potentially chemically toxic materials.

1. The unbagging and shoveling of the monazite ore, the first step in the process.
2. The breaking up of the thorium nitrate crystal in the finishing room, the last step in the process.

Both processes involve very few man hours of exposure. One man at each of the operations is employed for approximately one hour per day. As evidence of the absence of deleterious effects from working in and about the plant was a statement of the foreman, Mr. Harold Kirk, that a worker has for 45 years been engaged in the stirring out process of the nitrate without effects other than in this time he has overcome his former asthmatic condition. No other person has had to be discharged or has complained of effects from working in the plant. The plant foreman and chemist feel that the radiation effects have been overrated. The foreman himself has worked for a number of years (35) in and about the plant, very close to the material and has suffered no effects of any sort. At the present time, they have a million pounds of monazite ore stored in hundred-pound bags in a closed shed. To date they have made no radioactivity measurements on this or any other of their products in and about the building. In the finishing room on the day of our visit there were approximately ten 55 pound jars of thorium nitrate ready for shipment. In this room, one man was working continually at a distance of about 6 to 20 feet from this material. At other

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processes throughout the building, there were relatively large quantities of oxalate, sulfate, and hydroxide (in filter presses and in barrels). A relatively few individuals are employed in the thorium processes.

As regards the laundering problem, it should be noted that alkali soaps fix thorium compounds firmly on clothing to the extent of waterproofing it. Washing with cold water is probably best.

Chemistry. As regards absorption on laboratory apparatus, acidic solutions (nitric and hydrochloric) are probably best for removal of thorium from such ware.

According to their best information, the plant chemists know of no micro-method for the analysis of thorium other than that reported at the last A.C.S. meetings in New York.

They predicted that the following organic complexes would be insoluble: acetate, oxalate, nitrate, and carbonate, the latter however being soluble in excess of the carbonate solution. Anhydrous sulfate of thorium is soluble in cold water; the crystalline sulfate hydrate is insoluble in hot water. Mr. Kirk suggested calling George Rennick of the Manhattan Branch about analysis of thorium products of Dr. S. C. Lind of the Bureau of Standards.

Samples. Two air samples were obtained with the Modified Cascade Impactor, 1 for the operation of unbagging the monazite ore, the other at the finishing operation where thorium nitrate crystal is broken. These samples will be investigated by the Dust Laboratory Group.

Five 10 g samples of thorium compounds were also obtained for chemical research work. These were the chloride, the sulfate, acetate, thorium nitrate dodecahydrate and a sample of monazite ore.

Robert Wilson

George Sprague

H. E. Stokinger

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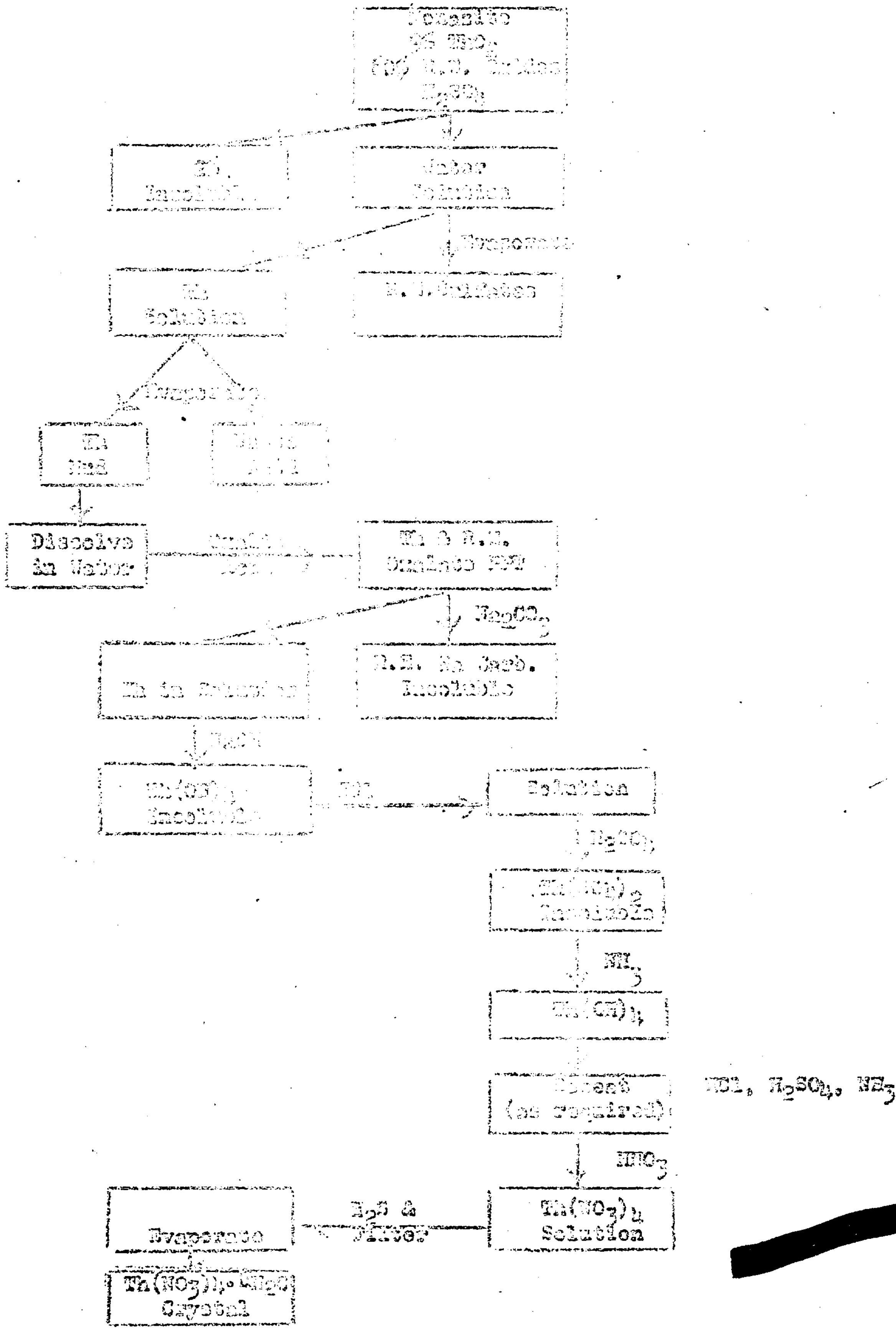
Figure 2. Steps in the Production of Thorium Nitrate
(Maywood Chemical Works)
1947



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