STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : John T. Sherman, Assistant Director for Domestic Procurement

DATE: February 26, 1957

FROM : E.C. VanBlarcom

SUBJECT: SOLVENT EXTRACTION OF PHOSPHORIC ACID

On the occasion of my visit to the Dow Chemical Laboratory February 13th, I took the opportunity to discuss with them their original work on the use of solvent extraction for recovering uranium from phosphoric acid. I told them that it was my understanding that the operating companies in Florida were experiencing serious loss of solvent and consequent high cost of this product.

Dr. Bailes and Ray Long explained to me that they had done the original work which was all reported in Dow-81. They said that they had worked cooperatively with both the Florida companies and with Anaconda. As their work neared completion they recognized the need for pilot plant work prior to plant design and so recommended. The Florida companies adopted the attitude that pilot plant work was unnecessary and proceeded with their plant design, on the basis of Dow's laboratory work plus whatever work they had done themselves on a small scale. Anaconda, on the other hand, took Dow's advice and set up a pilot operation. It is Dow's understanding that the Anaconda pilot work was even better than the laboratory work and indicated considerably less solvent make-up requirement.

Dr. Bailes was disturbed by my comment that the solvent loss being experienced in Florida is disappointing. He deplored the fact that pilotplant work had not been used to uncover this situation prior to plant operation.

The original work recommended that the OPPA should be made locally by dispersing P_2O_5 in the prepared alcohol. Capryl alcohol (an 8 carbon chain with an OH group attached to the carbon next to the end) was used in the laboratory work although there was indication that other alcohols might be equally useful. P_2O_5 reacts with the alcohol to form a pyrophosphoric ester. This compound is quite selective for uranium and has a reasonable capacity. It can be stripped with hydrochloric acid or strong phosphoric acid but HF is preferred. Unfortunately, however, OPPA is hydrolyzed by contact with any acid; thus degradation occurs on contact with commercial phosphoric acid but, more particularly, during stripping operation with HF. The hydrolysis products are primarily orthophosphoric esters but it is also probable that some of the original alcohol is separated from the compound.

The mixture of hydrolysis products is complex and this complexity increases during continued use in the solvent extraction circuit. Many of the hydrolyzed products are soluble in the aqueous phase and are thus lost to the commercial phosphoric acid. Other hydrolyzed products accumulate in the organic solvent. When using OPA Dow found that it was beneficial to add P_2O_5 continuously to the recycling organic. But in the case of OPPA they found substantially no benefit from P_2O_5 addition. The recommendation in Dow-81 is that OPPA is best made as a separate operation rather than subsequently added to the recycling solvent.

Dow's work indicated that solvent losses ranging from 50 to 100% could be expected, ~~on the basis of a 50% loss~~. Their calculation indicated a solvent loss amounting to $1.25 per pound of U_3O_8. Relative to the $25.00 per pound value which they contemplated at that time this reagent cost did not seem unreasonable.

The Dow work indicated that hydrolysis of OPPA is promoted by high temperature, contact with acids, and contact with certain impurities, notably fluorine. It is Dr. Bailes' feeling that if the process in operation is getting results less favorable than indicated in Dow-81 the cause is probably due to insufficient control of variables pointed out in Dow-81 which have an adverse effect. He said that he would be interested to learn of the operating conditions as presently practiced. A review of these conditions could lead to useful comment from him toward correcting adverse conditions.

In answer to my question if there might not be some other solvent for this work I was told that technically either DDPA or di-2-EHPA could be used with an HF aqueous strip but the Dow engineers feel that either of these would be less economical than OPPA. They also feel that heptadecyl orthophosphoric acid ought to be considered in the light of recent information on this solvent. It was not considered in the original work but Dr. Bailes considers that ~~this~~ its characteristic could be favorable.

At the conclusion of our conference Dr. Bailes ~~expressed himself as being distressed by the information that the process is not operating to the satisfaction of the processing companies, but he~~ said that he would be receptive to a request for assistance from those companies. From our point of view, considering the experience and capabilities of the Dow engineers, it would be highly desirable for a working arrangement to be established between the Florida phosphate operating companies and the Dow Chemical Company.