CONFIDENTIAL

TECHNICAL INQUIRY TAC-148

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Ion Exchange Resins -- Extension of Technical Studies

Reference technical assignment requested additional data on styrene-divinyl benzene type ion exchange resins which include (1) an additional evaluation of their 4A significance (2) a reexamination of the significance of water softening as a limiting element to their strategic significance and (3) a reexamination of the ion exchange resins used for uranium recovery.

Since the preparation of the fact sheet of July 1955, a great deal of data have been published which permit a more detailed report on these matters. Also we have obtained from two major producers the most detailed available information to them regarding production of ion exchange resins in Europe.

The particular resins covered by the proposed strategic definition are identifiable chemically as a styrene-divinyl benzene (cross linked polystyrene) ion exchange resins and are classed into the following types:

1. Sulfonated cation exchange resins.
2. Carboxylic cation exchange resins.
3. Strongly basic anion exchangers.
4. Weakly basic anion exchangers.
5. Mixed base anion exchangers.

Ion exchange resins of commercial significance not covered by the above are the following:

	Trade Name
Sulfonated coals	Zeo-Karb
Sulfonated phenol-formaldehyde resins	Zeo-Rex, Duolite C-3

1. Evaluation of 4A SIGNIFICANCE

a. Producers in Free World Countries are the following:

(The numbers identify the types as listed above, which are produced by each firm).

West Germany

a) Permutit A.G., Berlin 1,2,3,4

b) Farbenfabrieken Bayer, Leverkusen 1,2,3,4.

East Germany

Holland

a) Aetivit N.V. 1,2,3,4,5.

United Kingdom

a) Permutit Co., Ltd. 1,2,3,4,5.

b) United Water Softeners Ltd. 1,2,3,4,5.

c) Jas Crosfield & Sons Ltd. 1,3,4.

d) Chas. Lenning & Co. 1,3.

Italy

a) Montecatini 1,2,4.

France

a) ACFI. 4

Norway

a) Norsk-Hydro 4

Japan

a) Mitsubishi Kasei 1,3,4.

b) Tokyo Yuki Kagaku Kogyo, K.K. 1,3,4.

The largest producers are Permutit and Bayer of West Germany, Aetivit of Holland, and Permutit and Lenning of London. Other organizations are of relatively minor importance. Two major domestic suppliers (Dow & Permutit) report they have no figures relative to quantities produced in foreign countries. They report that the resinous types are produced in small quantities in West Germany and United Kingdom as well as in Japan, Holland and Italy. Permutit Co. states that they are exporting large quantities to West Germany, Japan, and to many places in the British Commonwealth.

It should be noted of the above-listed manufacturers in countries with significant production, those not affiliated with the major U.S. manufacturers are only the Farbenfabriken Bayer, W. Germany; Aetivit, Holland; Jas. Crosfield & Sons Ltd., England. It was indicated by U.S. producers that the productivity of these three firms is limited.

Many other suppliers offer ion exchange resins for minor uses under their own trade names. These companies purchase the basic materials from the above listed producers and relable.

b. Production in Bloc areas

I.G. Farben in East Germany produces all but the strong base ion exchange resins. There have been indications of other production but available information is meager on the subject.

2. STRATEGIC USES OF ION EXCHANGE RESINS

Uses for the ion exchange resins involve one or a combination of resin types. New ion exchange resins of the polystyrene chemical group are being used under conditions that formerly caused rapid deterioration. They resist oxidizing and reducing atmospheres, elevated temperatures and strongly acid or alkaline environments.

a. Water conditioning is the single most important ion exchange application. This process has been an element of increasing importance in manufacturing processes as advanced technology has led industry, particularly the chemical industry, to special products or procedures possible only with the use of highly purified water. Ion exchange resins produce a pure water, equivalent to that obtained by multiple distillations with special corrosive resistant equipment. Through various combinations of exchange resins various desirable results may be obtained.

(1) Demineralization with silica removal. This process purifies water used in modern turbine engines, 2,000 HP and over (MESL Item 2270). Estimated annual sales volume of resin for high pressure boiler water is $5 million.

(2) Demineralization without silica removal includes uses such as purifying water for boiler feed, chemical processing metal plating and synthetic fiber manufacture. Estimated annual sales volume is $6 million.

(3) Mixed bed demineralization (the same resins in special processing facilities) is used to produce the highest purity water and is required for television and radar tube manufacture, synthetic fiber production, high pressure boilers, and other industrial uses. Estimated annual sales volume is $3 million.

b. Hydrometallurgy involves the recovery of metals from solutions. The principal commercial application has been in the recovery of metals from industrial wastes, and the removal of metal poisons from industrial water. Copper and zinc now are thus recovered on a large scale. A tabulation of ion exchange applications in hydrometallurgy covering commercial, pilot plant and research work identified 85 different procedures involving practically all metals, and all types of the resins. This is an indication of the extensive usefulness of these products. Commercial isolation of the rare earth metals is made possible with ion exchangers, as is the extraction of uranium.

In summary, uses of strategic importance for ion exchange resins include: Treatment of boiler water for high pressure turbines, isolation of rare earth and other elements; radar tube manufacture, synthetic fiber production; recovery of metals, production of low acid formaldehyde for explosives manufacture, production of streptomycin and other antibiotics and the extraction of uranium.

3. URANIUM RECOVERY WITH ION EXCHANGE RESINS

Ion exchangers have a vital role in uranium recovery from ores. Strong base anion exchange resin is used to absorb uranyl sulfate from solution. A number of different techniques have been developed, each depending on the inherent conditions of the ore.

Since 1952 a large number of plants have adopted ion exchange resins for uranium recovery. By number there are 26 plants in the Union of South Africa, 10 plants in Canada, 8 in the United States, 2 in Australia and one in Belgian Congo. In this country, the ore is treated only for uranium recovery. In other areas the ore may be treated similarly or only after other minerals have been removed. In either case ion exchangers are used in recovery, this process being the major source of available uranium.

4. SUMMARY

a. Strategic uses by type for the various polystyrene copolymer ion exchange resins, are the following:

(1) Cation exchangers

Strong acid resins

(a) Demineralizing water for turbines.

(b) Hyper pure water for industrial use.

Weak acid resins

Streptomycin production

(2) Anion exchangers

Weakly basic resins

Demineralizing water for steam turbines.

Mixed base - Limited commercial use. May contain both types of basic resins

Strongly basic resins

Water for steam turbines (a) Demineralizing, (b) Hyper pure water for industrial use, (c) Uranium recovery.

b. The definition recommended covers products which can be identified as particular chemical types, the cross-linked polystyrene ion exchange resins, and we believe these are the only strategically important synthetic ion exchange resins.

The other resins most commonly used for home and industrial water softening not requiring high efficiency are the "Zeo-Karb" sulfonated coals. Also sulfonated phenol formaldehyde exchange resins are not covered by the strategic definition as they are not used at present to any degree. One major producer reports they have practically discontinued production of these.

We consider water conditioning that requires styrene type resins to be strategically significant for the above-mentioned industrial uses. Ion exchange resins also have great technological significance, in that they are necessary for processes requiring a special degree of quality control. Finally, available information of foreign productions indicates that the U.S. is the principal world supplier.

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CEP PROGRAM DETERMINATION NO. [redacted] (Revised)

E. Placement of Items on Part C-III (Individual Item Control) of U.S. Master Export Security List.

(Explanatory Note: This Part comprises items the export of which to the Soviet Bloc the U.S. has determined should be subjected to control and for which there is no current multilateral agreement by CoCom to controls identical with those of the U.S.)

An item shall be placed on Part C-III if it meets both Standards No. 1 and 2, and either Standard No. 3 or 4.

Standard No. 1. The item possesses one or more of Attributes Nos. 3, 4, and 5, and Standard No. 1 under Part C-I or Standard No. 1 under Part C-II is met.

Standard No. 2. The coverage already afforded by the placement of related items on the U.S. Master Export Security List is inadequate to achieve U.S. security objectives.

Standard No. 3. It can be reasonably expected that U.S. negotiations would be successful in obtaining satisfactory multilateral control by CoCom provided, however, it is reasonably clear that such negotiations or resulting control would not cause:

(a) An expenditure of good will or bargaining power disproportionate in terms of U.S. national security interests; or

(b) An undue impact on the economic, political, or financial situations of the member countries.

Standard No. 4. Where the U.S. does not intend to seek multilateral control by Cocom or has not been successful in obtaining adequate control agreement by CoCom:

(a) Such additional strategic commodities as would contribute significantly to the war potential of the European Soviet Bloc, the U.S. unilateral control of which can reasonably be expected, because of U.S. production, supply or technology, to be effective in depriving the European Soviet Bloc of a significant contribution to the latter's war potential; or

(b) Other commodities, whether strategic or not, which raise such special political problems as to warrant U.S. export control to the European Soviet Bloc despite the absence of international controls.

NOTE: The degree of control to be applied to an item on Part C-III shall be determined on the merits of each item in terms of (a) the possibility of achieving effective control, including the use of licensing guides, and (b) any overriding considerations of U.S. policy.