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PROJECT REPORT

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HAV-93a

HAVEG-41
COMPOSITION OF FILLER AND EFFECT OF EXPOSURE TO HCL SOLUTIONS

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SUMMARY The filler in Haveg-41 has been identified, using X-ray diffraction analysis, as a mixture of talc (an hydrated magnesium silicate) and a long-fibered or amphibole asbestos. This asbestos corresponds closely to the structure given for anthophyllite, 7(Mg, Fe) $0 \cdot 8\ SiO_2 \cdot H_2O$, but the structure of actinolite or tremolite, $Ca_2(Mg, X)_5\ O_7 \cdot 8\ SiO_2 \cdot H_2O$, is probably more correct. Mr. W. H. McGoldrick requested the examination of Haveg-41, which is an asbestos-impregnated phenolic resin used in the column and packing support in the chlorine removal column in the Fluorocarbon Unit at the Institute plant, to aid him in determining why the column was leaking, what the composition of the filler is, and what effect solutions of HCl have upon the filler.

Three samples of Haveg-41, representing (a) material from a previous production lot, (b) this material after 48 hours in boiling 10 per cent HCl, and (c) material that had failed in use, were examined with X-ray diffraction. The filler in all three samples consists of a mixture of asbestos and talc. The ratio of asbestos to talc decreases significantly from (a) to (c), indicating an attack of the asbestos by prolonged exposures to HCl in aqueous solution.

There are two general types of asbestos, the long-fibered, such as, anthophyllite and the short-fibered, such as, chrysotile. Although the short-fibered asbestos is the more common and desirable as an insulator due to better nonconductivity and strength, both are decomposed by prolonged exposure to acids. Thus, neither one may be suitable as a filler in Haveg-41 for this application.

No further work is anticipated on this project.

INTRODUCTION In February 1967 "white crystals" were observed growing on the outside of the chlorine removal column in the Fluorocarbon Unit at the Institute plant. These crystals contained large amounts of calcium, potassium, and chlorine and small amounts of magnesium and silicon as determined by emission analysis. A hair-line crack also was noticed in the side of the column where the crystals were growing through which was seeping strong HCl solution from inside the column.

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Mr. W. H. McGoldrick in the Corrosion group of the R&D Department subsequently undertook to determine the cause of cracking, the nature of the filler in the column and packing material, and the effect of prolonged exposure of the column material to aqueous solutions of HCl. The column and packing material, Haveg-41, reportedly is a phenolic resin impregnated with 60 to 70 per cent asbestos.

The results of X-ray diffraction analyses, requested by Mr. McGoldrick to determine the composition of the filler in Haveg-41 and the effect of HCl upon the filler, are presented in the following paragraphs. In addition, a comparison between the two types of asbestos is presented.

DISCUSSION The filler in Haveg-41, a phenolic resin impregnated with 60 to 70 per cent asbestos, has been identified as a mixture of talc and a long-fibered amphibole asbestos. Talc is a hydrated magnesium silicate, $3\ MgO \cdot 4\ SiO_2 \cdot H_2O$, which is resistant to attack by acids. The long-fibered asbestos in Haveg-41 has the structure of anthophyllite, $7(Mg, Fe)\ O \cdot 8\ SiO_2 \cdot H_2O$, according to the literature (1). However, according to another source (2) the structure probably corresponds more nearly to actinolite or tremolite, $Ca_2(Mg, X)_5\ O_7 \cdot 8\ SiO_2 \cdot H_2O$, where X is sodium, aluminum, iron, etc. The asbestos in Haveg-41 is attacked by aqueous solutions of HCl and decomposes after long use in the chlorine removal column in the Fluorocarbon Unit at the Institute Plant.

Experimental

Three samples were submitted by Mr. McGoldrick for X-ray diffraction analysis: (a) material from a previous production lot, (b) this material after 48 hours exposure to boiling 10 per cent HCl, and (c) material that had failed in use in the Fluorocarbon Unit. Conventional X-ray diffraction techniques were used in the analysis and the samples were rotated in the plane of their surfaces to eliminate orientation affects, thereby giving reliable comparative quantitative diffraction data. The testing in the HCl solutions and the sample preparation, cutting and polishing, were done by Mr. G. B. Elder.

Composition and Change of the Filler in Haveg-41

The composition of the filler in Haveg-41 and the change in composition of the filler upon exposure to aqueous solutions of HCl are given in Table I. The composition of the filler is originally about 55 per cent anthophyllite and 45 per cent talc. The concentration of anthophyllite is reduced to about 49 per cent after 48 hours in boiling 10 per cent aqueous HCl and to about 25 per cent after prolonged exposure to the HCl solution in the chlorine removal column.

According to the literature (2), asbestos can form talc, among other products, upon decomposition. However, our observations show a decrease in the amount of the asbestos in Haveg-41 but not a corresponding buildup of talc.

The data in Table I show a decrease in the concentration of the asbestos and implies that there is a corresponding increase in the concentration of talc, also. However, talc was not found in the products formed by the attack of the HCl solution upon the filler in Haveg-41. The residue remaining after evaporation of the HCl solution used in the 48-hour test was identified as a mixture of approximately 35 per cent sodium chloride, 35 per cent hydrated magnesium chloride, and 30 per cent hydrated calcium chloride. Silicon dioxide was observed in this residue also after extracting with acetone. These data show that the anthophyllite in the filler is attacked by the HCl solution and decomposes to form the chlorides of sodium, magnesium, and calcium plus some silicon dioxide, and evidently does not form additional talc. Thus, the amount of talc remains constant but its relative concentration increases as the asbestos decomposes.

Comparison of the Two Types of Asbestos

The more commonly used asbestos for insulation applications is the short-fibered or serpentine type having a structure, such as chrysotile, $3\ MgO \cdot 2\ SiO_2 \cdot 2\ H_2O$ (1). Chrysotile is a better nonconductor of heat and the fibers have greater strength than the long-fibered or amphibole type, such as anthophyllite, or the more exemplary actinolite or tremolite. The heat resisting properties and the susceptibility to attack by acids, however, is about the same. In this application, therefore, one type may be as good as the other. This could only be determined by additional testing of both types or searching of the literature.

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BIBLIOGRAPHY

(1) X-Ray Powder Diffraction File.
(2) Krause, Ramsdell, and Hunt, Mineralogy, McGraw-Hill Book Company, Inc., 1959.

NOTEBOOK REFERENCE: 17KJG-90 and 93

Attachment:
1 Table

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TABLE I

HAVEG-41

COMPOSITION OF FILLER AND EFFECT OF HCL TREATMENT

Sample and Description	Composition, Approximate per cent (a) Anthophyllite (b)	Talc (c)
Original Production Material	55	45
Original Production Material, after 48 hours in boiling 10% HCl	49	51
Material from Column Support	25	75

(a) Estimated from relative intensity of strongest reflection for each component in the diffraction pattern of the samples.

(b) $(Mg, Fe)_7\ Si_8O_{22}(OH)_2$ from the X-ray Powder Diffraction File.

(c) $Mg_3Si_4O_{10}(OH)_2$ from the X-ray Powder Diffraction File.

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