MEMORANDUM

DATE: February 8, 1979

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SUBJECT: VISCOSE RAYON FIBER PRODUCTION — PHASE I INVESTIGATION

The purpose of this memorandum is to present pertinent information regarding the viscose rayon fiber production process acquired after completion of the draft Source Category Survey Report on the Synthetic Fibers Industry. Information contained in this memorandum was obtained through plant visits to Avtex Fibers, Incorporated in Front Royal, Virginia and American Enka Company in Lowland, Tennessee. Both plants utilize the viscose process to produce rayon fibers.

UNCONTROLLED EMISSION RATES

In the draft Phase I report, the ratio of carbon disulfide (CS_2) to cellulose required to form the sodium cellulose xanthate was reported as 0.47 pounds of CS_2 per pound of cellulose. This theoretical value was determined stoichiometrically from the process chemical reactions. However, both American Enka and Avtex Fibers indicate that in industrial practice the quantity actually used is about 70 percent of the theoretical quantity. Thus, the ratio is nearer to 0.30 pounds of CS_2 per pound of cellulose.

It was also learned that about 15 to 20 percent of the original CS_2 is converted to H_2S due to side reactions. The amount of H_2S formed as a by-product was initially found to be 6 percent.

The quantities of CS_2 and H_2S emitted from an uncontrolled viscose rayon fiber facility are therefore lower than originally reported in the draft Phase I report. Uncontrolled emission rates for the viscose process were determined to be 240 pounds of CS_2 and 26 pounds of H_2S per 1000 pounds of rayon fiber produced.

CARBON DISULFIDE RECOVERY

Of the domestic rayon manufacturing facilities, only American Enka currently attempts to recover any of the CS_2 used in the viscose process. American Enka recovers approximately 14 percent of the 37 million pounds of CS_2 consumed annually in the production of viscose rayon at the Lowland, Tennessee plant (about 5 million pounds of CS_2 per year). Collection of CS_2 for recovery occurs only at the "hot dip" stage of their process line; other stages along the process line (e.g., spinning, washing, and drying) are uncontrolled.

CS_2 recovery is attempted only at the hot dip stage because here the concentration of CS_2 is high enough and the gas volume is small enough to make collection and recovery of the CS_2 vapors technically and economically feasible. The hot dip bath is a tightly closed system (with a water seal around the lid of the bath) used to remove impurities from the fiber and to promote continued regeneration of the cellulose fiber immediately after it emerges from the spinning bath. CS_2 gas is removed through a header to the recovery system where it enters a counter-current scrubber (actually a condenser) through the bottom. Cold caustic soda enters at the upper portion. The CS_2 vapors are condensed on tray-type condensers to liquid and are subsequently pressed back to storage where it is kept under a layer of water to prevent evaporation.

Although American Enka realizes an overall recovery of 14 percent of the original amount of CS_2 input to the process, the efficiency of the recovery system itself is considerably higher with nearly all the CS_2 and H_2S input to the recovery system collected.

Assuming a recovery rate of 14 percent of the original 300 pounds of CS_2 input per 1000 pounds of cellulose, this controlled facility would emit about 258 pounds of CS_2 per 1000 pounds of fiber produced (without accounting for H_2S formation).

It should also be noted that Avtex Fibers, Inc. has made attempts in the past, all with negative results, to recover CS_2 through use of a carbon adsorption system. They found that recovery of CS_2 was technically as well as economically infeasible.

MARKET TENDS AND DEVELOPMENT OF NON-VISCOSE RAYON PROCESS

The draft Source Category Survey Report projected an annual growth in demand for rayon fibers of 4 percent per year over the next five years and that beneficial economic conditions are expected to permit rayon fiber production capacity increases of about 100 million pounds over the same period. Recent industry publications indicate that rayon demand is on the increase as a result of the declining cotton production and the raw material advantage of the rayon process (raw materials are not tied to the petroleum industry). Industry officials at American Enka and Avtex Fibers, however, disagree; they clearly state that no increases in rayon capacity are planned for the five year period through 1985. Representatives of both companies stated that the high capital cost of construction would prohibit any increase in viscose rayon capacity. (The viscose process of manufacturing rayon fiber is labor, energy, and maintenance intensive.)

When questioned about the fact that Avtex Fibers, Incorporated has scheduled a 100 million pound expansion of its rayon staple capacity at a cost of $50 million, Avtex representatives stated that the project was in actuality not an expansion of capacity but an upgrading of existing production facilities. Avtex also noted that the project has been placed on hold and will not be completed. These claims were supported by the recently announced closing of the Avtex Fibers' Nitro, West Virginia rayon plant. This rayon manufacturing facility originally constitued approximately 25 percent of the total production capacity of rayon fibers in the U.S.

The closing of the Avtex Fibers Nitro plant further clouds the rayon market situation. Demand for rayon will soon outstrip current production capacity. However uncertainty exists as to whether or not rayon manufacturers will abandon the present viscose process for a non-viscose process in order to meet increasing demand. Industry sources report that the high capital cost of construction of viscose rayon production facilities will in all likelihood prohibit further expansion of the viscose rayon capacity; yet, the same industry sources indicate that the new non-viscose processes are currently only in the developmental stages. If this is the case, it would appear that the rayon industry will not increase capacity to meet increasing demand until the new non-viscose process can be implemented.