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STUDIES ON THE CATALYTIC SYNTHESIS OF VINYL ETHERS FROM ACETYLENE AND ALCOHOLS

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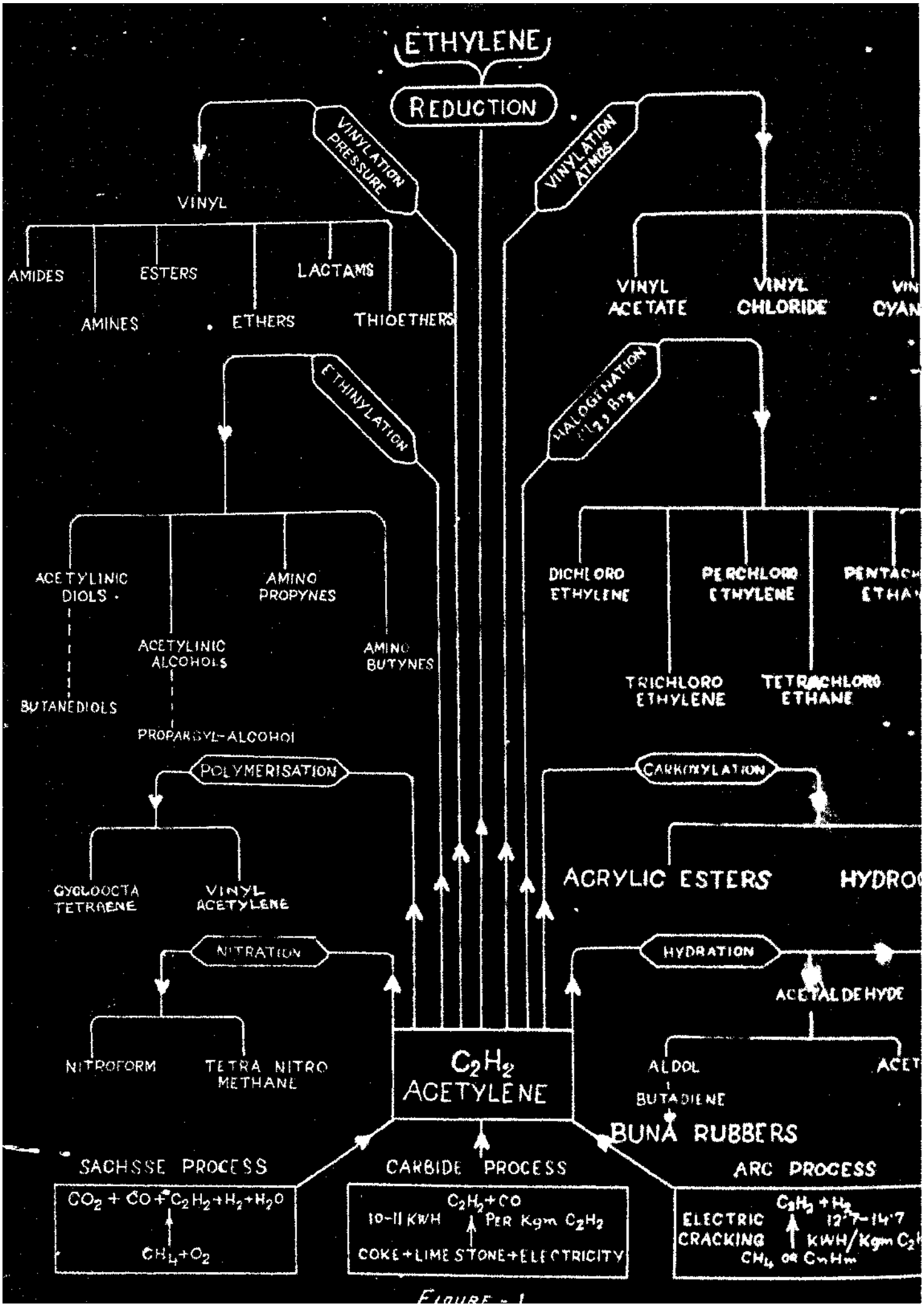
ETHYLENE
REDUCTION
VINYLATION PRESSURE
VINYLATION ATMOS
VINYL
AMIDES
ESTERS
LACTAMS
AMINES
ETHERS
THIOETHERS
VINYL ACETATE
VINYL CHLORIDE
ETHINYLATION
HALOGENATION
ACETYLINIC DIOLS
AMINO PROPYNES
ACETYLINIC ALCOHOLS
AMINO BUTYNES
BUTANEDIOLS
PROPARGYL-ALCOHOL
DICHLORO ETHYLENE
PERCHLORO ETHYLENE
TRICHLORO ETHYLENE
TETRACHLORO ETHANE
POLYMERISATION
CARBONYLATION
CYCLOOCTA TETRAENE
VINYL ACETYLENE
ACRYLIC ESTERS
NITRATION
HYDRATION
ACETALDEHYDE
NITROFORM
TETRA NITRO METHANE
C_2H_2 ACETYLENE
ALDOL
BUTADIENE
BUNA RUBBERS
SACHSSE PROCESS
CARBIDE PROCESS
ARC PROCESS
$CO_2 + CO + C_2H_2 + H_2 + H_2O$
$CH_4 + O_2$
$C_2H_2 + CO$
10-11 KWH PER Kgm C_2H_2
COKE + LIME STONE + ELECTRICITY
$C_2H_2 + H_2$
ELECTRIC CRACKING
12·7-14·7 KWH/Kgm
CH_4 or C_nH_m

FIGURE - 1

PREFACE

One of the outstanding developments in chemical industries, during the last three decades, has been the use of acetylene as a starting material in various chemical syntheses. This development of acetylene chemistry had been most spectacular in the period of World War II in many countries, particularly in Germany. Being highly reactive in nature acetylene can be made to yield almost any carbon compound by subjecting it to different chemical treatments. This is clearly indicated by the fabulous "Acetylene tree", yielding its various fruits, ranging from synthetic rubber to blood plasma substitute, from clear glass like plastics to viscous adhesives, and from common simple chemicals like acetic acid to brightly coloured complex hydrocarbons like cyclo-octatetraene.

The most noteworthy feature of acetylene is that, it can be produced directly from coke and lime, the only other requirement being cheap electric power. With the advent of atomic age, the availability of cheap electricity will increase enormously, Hydel power contributing its own share, and we can confidently look forward to the era when acetylene shall be the basis of a major portion of synthetic chemical industry, specially in those countries which have practically no source of natural petroleum.

It is claimed that extensive researches have been carried out on acetylene chemistry, particularly in Germany, but publication in this field is extremely meagre; only references which could be traced are the various reports of the agencies like Field Information Agency, Technical (FIAT) and the British Intelligence Objective Sub-committee (BIOS) where the pioneering and outstanding work of Dr.Julius W.Reppe' stands unique. Reppe' has, in fact, opened up a number of new fields in acetylene chemistry i.e. vinylation reactions, ethinylation reactions, polymerisations and carboxylation. Following his lead, many radically new processes have been developed for syntheses of little known organic chemicals, which have great industrial importance.

Amongst the various acetylene derivatives vinyl compounds find important applications in plastic industry. Being in great demand, attention was paid to find out new methods for the production of vinyl compounds like, vinyl acetate, vinyl chloride, and particularly vinyl ethers. These researches ultimately culminated to the important discovery of the general method of direct vinylation. Unfortunately however, details on this process of vinylation are totally lacking.

It was therefore decided by the present author to undertake detailed investigations on the

above-mentioned process and to evaluate the industrial feasibility of the same. The investigations carried out and presented in this thesis deal with the vapour phase, as well as the pressure vinylation of alcohols in presence of catalysts for the production of vinyl ethers.

Part I of the thesis deals with the studies on the vapour phase catalytic vinylation of methanol, ethanol and n-propanol to the respective ethers. The effects of reaction temperature, space velocity and reactant ratio on conversion have been reported separately. Activities of various important catalysts have also been evaluated.

Part II of the thesis is related to the studies on pressure vinylation of Ethanol. Effects of temperature, residence period and gas concentration, have been examined and results obtained were compared with the results claimed by German investigators. Some differences in the conversion percentage were noted. The difficulties and precautions against dangers, associated with the handling of acetylene under pressure, have been described in detail.

The activities of vapour phase catalysts and their surface area measurements, are the subjects of study in the Part III of the thesis. The surface area of important catalysts was measured by the gas adsorption method of Brunauer, Emmett and Teller and the results have been tabulated.

Finally the thesis has been summarised and economic feasibility of the process has been discussed. A comprehensive review of existing literature on this subject has been included at the end of each part.