

RESTRICTED

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ENCLOSURE (B) 15

**STUDIES ON THE SEPARATION
OF ACETYLENE**

by

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SUMMARY

By the extraction with water at high pressure, acetylene was separated from a mixed gas composed of 20% acetylene, 50% hydrogen, and 20% methane. The mixed gas was obtained by the arc cracking of hydrocarbon gases. The separated acetylene had a purity of 95% or more, and the amount of acetylene in the residual gas was less than 1%. This was removed by treating the gas with nickel catalyst at 350°C.

I. INTRODUCTION

Cracked gas obtained by arc cracking of lower hydrocarbon gases consists of 20% acetylene, 50% hydrogen, and 20% methane.

To use these gases as the raw material of synthesis, it was necessary to concentrate or separate acetylene. The separation of acetylene from mixed gas has not yet been done on commercial scale. As acetylene has a good solubility in water compared with methane and hydrogen, the author attempted to separate acetylene by water extraction and devised an apparatus. After several experiments improvement of the apparatus was accomplished and tests were made. On the basis of these results a commercial plant was erected at the Second Fuel Depot of YOKKAICHI. It was begun in April, 1940 and completed in September, 1942.

II. DETAILED DESCRIPTIONA. The Apparatus and Experimental Procedure

The flow sheet of the apparatus is shown in Figure 1(B)15. Mixed gas from gas holder (a) is drawn through the stripping tower (m) and compressed and sent to an absorbing tower (b). Water is pumped in the absorbing tower by pump (d) from a water tank (e). The solution at the bottom of the absorbing tower is released at the medium pressure tower (f). The residual gas from the top of the absorbing tower (b) which contains scarcely any acetylene is introduced to the hydrogenation plant of the residual acetylene without releasing the pressure. This part of the plant consists of a heat exchanger (g), a preheater (h), a converter (i), and a cooler (j).

The function of the medium pressure tower is to increase the purity of acetylene. Gas is expelled by the solubility difference according to the decrease in pressure. Expelled gas which consists of almost all methane and hydrogen and a part of acetylene dissolved in water at (b) was mixed in charging gas before the compressor (c).

Water at the bottom of (f) is released to atmospheric pressure tower (k) and almost all acetylene is expelled. Acetylene from the top of (k) has a purity of 95% or more. Water at the bottom of (k) is sent by a pump (l) to the stripping tower (m). Water from the bottom of (l) which contains scarcely any acetylene, according to the solubility at the partial pressure of (m) returns to the water tank (e). The absorbing tower is 150mm in diameter and 10m in height. This plant has a charge capacity of arc cracked gas of 20m³ per hour.

The test procedure was as follows. When the running became smooth, gas samples for the analysis were drawn from each part of the plant. Gas analysis was made by modified Hempel's method.

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B. Experimental Results

Conditions of running

Rate of charging gas	20 m ³ /Hr
Rate of recycling water	5 m ³ /Hr
Pressure of (b)	20 atm. p. on gauge
(f)	3 atm. p. on gauge
(k)	0 atm. p. on gauge
(m)	0 atm. p. on gauge

Analysis of charging gas

C ₂ H ₂	18.3%
H ₂	56.1%
CH ₄	23.5%
CO ₂ , O ₂ and N ₂	3.1%
Temp. of recycling water	18°C
Rate of gas from to of (b)	13.5 m ³ /Hr

Analysis of gas from top of (b)

C ₂ H ₂	0.8%
H ₂	70.3%
CH ₄	26.5%
Rate of gas from to of (f)	23 m ³ /Hr

Analysis of gas from top of (f)

C ₂ H ₂	51.6%
H ₂	11.4%
CH ₄	35.4%
Rate of gas from (k)	37 m ³ /Hr

Analysis of gas from top of (k)

C ₂ H ₂	95.8%
H ₂	1.0%
CH ₄	2.8%

Analysis of gas at the suction of the compressor

C ₂ H ₂	20.5%
H ₂	52.3%
CH ₄	25.3%

The contents of acetylene in the residual gas, if the height of the absorbing tower is sufficient, is determined by the quantity of acetylene dissolved in recycling water.

Gas from the top of the absorbing tower was introduced into the hydrogenation plant. The convertor is packed with nickel catalyst of U.O.P. type and gas, heated to 350°C. was passed through the catalyst at the space velocity of 10,000 volumes of gas per volume of catalyst per hour. Acetylene contained in gas was hydrogenated and reaction with Illosbay's reagent had shown no colouration for four weeks. As the gas treated by this method contains no acetylene, the separation of hydrogen from the residual gas can be done with Linde's machine with no danger.

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III. CONCLUSIONS

From mixed gas consisting of 20% of acetylene, 50% of hydrogen, and 20% methane, acetylene having a purity of 95% or more was separated by high pressure water extraction.

The residual gas containing less than 1% of acetylene was hydrogenated on nickel catalyst at 350°C; it is possible to treat with Linde's machine for the separation of hydrogen without danger.

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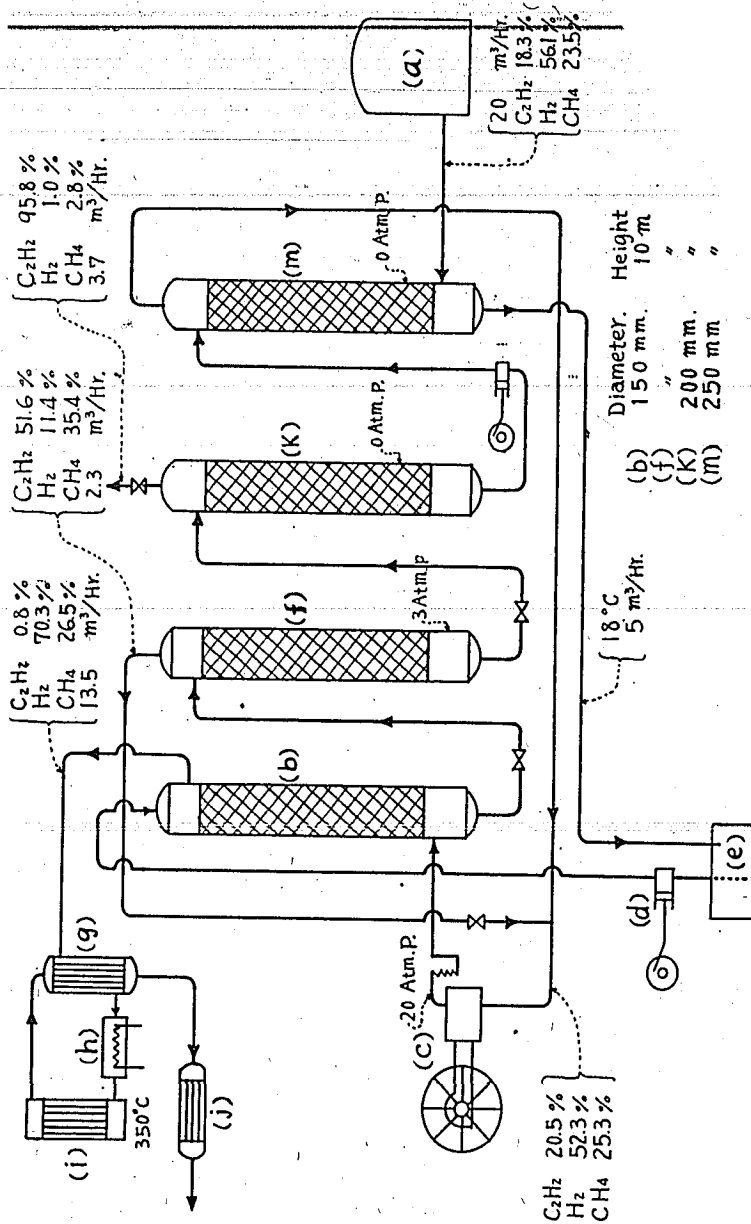


FIGURE 1(P) 15
FIGS. SHEET OF C_2H_2 SEPARATION