

RESTRICTED

X-38(N)-3

ENCLOSURE (B) 6

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THE DESIGN  
OF A  
SIMPLIFIED ALCOHOL DISTILLATION PLANT

by

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I. INTRODUCTIONA. History of Subject

By order of the Naval Supply Office, work was started in April, 1945, on the design of a distillation plant to produce 500 kiloliters per year of second class Alcohol (alcoholic content above 94%) from spirit with alcoholic content of 30%, made from sweet potatoes by the sake-breweries.

On the basis of this design, the equipment was constructed by the Chemical Engineering Department and the plant erected at the Iinuma sake-brewery in CHIBA Prefecture. A performance test of this plant was made in July, 1945.

B. Key Research Personnel Working on the Project

Nav. Eng. T. SHIBAZAKI  
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II. DETAILED DESCRIPTION

A flow sheet of the process is given by Plate I(B)6.

The raw spirit to be rectified is pumped from the reservoir to the feed gravity tank and it flows down, under constant head, to the preheater, where it is heated to about 65°C, and the liquid is charged to the rectifier. The concentrated vapor (alcoholic content of about 95%) from the top of the column is sent to the preheater and condensers. The residual gases, such as aldehydes, are discharged to the atmosphere.

A part of the condensate from the preheater and condenser is cooled and sent to product, the remainder plus condensate from the reflux condenser is returned to the rectifier as reflux.

The waste, with alcoholic content of less than 0.1% by volume, is withdrawn from the bottom of the rectifier through an automatic liquid level regulator.

Heat necessary for the distillation is provided by stripping steam introduced at the bottom of the column. Two outlet pipes are provided to take out fusel oil accumulated in the column.

The design operating conditions and the material and heat balances summarized below and on Figure 1(B)6 and Table II(B)6

A performance test was made on July 31, 1945, and the results are summarized in Table I(B)6.

III. CONCLUSIONS

This apparatus was shown to be suitable for practical usage. It had reserve capacity; and only three men, including 1 distiller, 1 fireman, and 1 assistant, were required for its operation.

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Table I(B)6  
PERFORMANCE TEST RESULTS

	Quantity	Concentration of Alcohol	Absolute Quantity of Alcohol
Input raw spirit	277.4kg/hr	25% by weight	69.35kg/hr
Output product	75.3kg/hr	92% by weight	69.30kg/hr
Loss of alcohol			0.05kg/hr

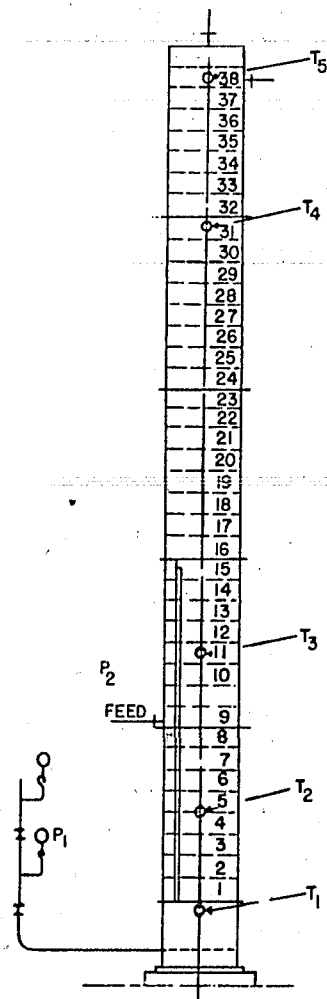


Figure 1 (B)6  
ALCOHOL  
DISTILLATION  
TOWER  
DIAGRAM

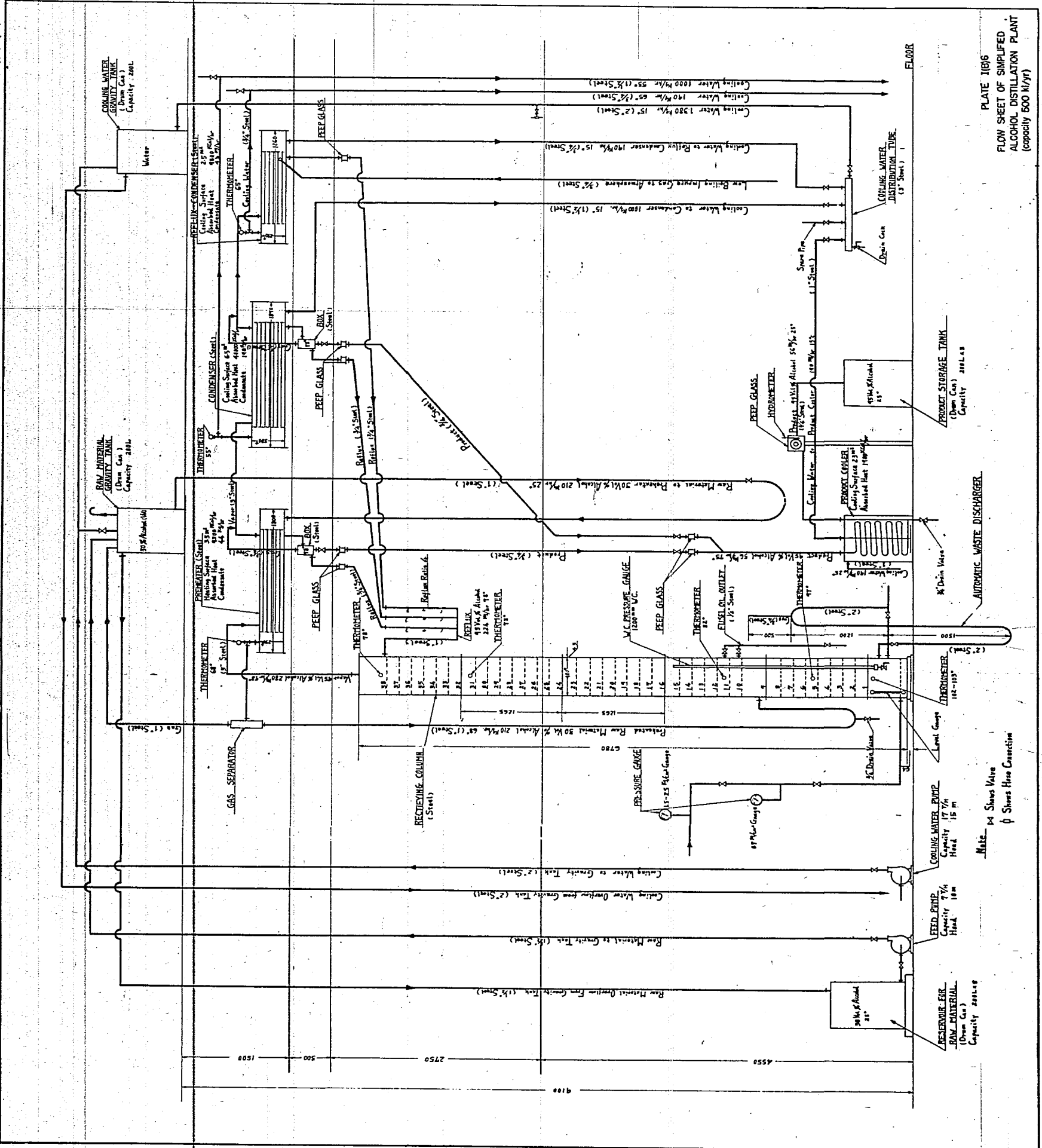


PLATE 1066  
 FLOW SHEET OF SIMPLIFIED  
 ALCOHOL DISTILLATION PLANT  
 (capacity 500 kg/yr)

— Matic — Shows Valve  
 — p — Shows Pipe Connection

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Table II(B)6  
TEST RESULTS OF SIMPLIFIED ALCOHOL DISTILLATION APPARATUS\*

Time (h:m)	Raw Material Probe: Octane	Temperatures										Pressures				Quantity				Alcohol Content (vol-%)	
		Rectifying Column				Cooling Water				Product Tank	Boiler Pressure (PSI)	Rectifying Column Pressure (kg/cm <sup>2</sup> gage)	Bottom of Column Pz (column)	Product Inlet (kg/hr)	Raw Material Inlet (kg/hr)	Cooling Water Condensate (kg/min)	In-Flux Condenser (kg/min)	Raw Material Product	By-Product		
		T1	T2	T3	T4	T5	T6	T7	T8											Condenser Outlet	Reflux Condenser Outlet
9:00	68	102.5	100	82	78.5	78	52	19	17.5	22	15	0.75	1050	1.97	1721	3.98	21.4	8.5	30	95.2	
9:30	68	102.5	100	82	78.5	78	49	19	17.5	22	19	0.6	1050	1.70	1605	693	18.5	8.5	30	95.2	
10:00	68	102.0	98	83	78	77.5	52	20	18	22	20	1.15	1050	1.34	1439	35.4	15.4	29.7	95.95		
10:30	55	102.5	93	82	78.5	78	52	19	20	21	40	0.9	1130	1.48	2385	31	38.3	1.4	29.8	95.9	
11:00	56	103.0	97	82	78	77.5	49	18	19	21	37	0.8	1070	1.46	1.62	38	1.2	29.8	95.0		
11:30	58	103.0	98	83	78.5	78	49	18	23	22	38	0.7	1100	1.8	2511	41	12.2	2.4	29.9	95.1	
12:00	59	103.0	97	82	78.5	78	50	25	25	22	40	0.8	1230	1.6	5.97	2579	44.7	2.8	30	95.1	
Mean of Normal State	57	102.9	98.2	82.5	78.37	77.87	50	20	21.75	21.5	34.75	0.8	1132.5	1.55	5.77	2492.64	39.8	1.95	29.87	95.0	

\*Normal state was from 10:30 to 12:00

\*Capacity: 5000 kg/yr (300 days operation)  
 \*Raw material: 31.5% N.O.  
 \*Raw material reservoir temperature constant at 20°  
 \*Cooling water inlet temperature constant at 17°