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Progress Report for October - November, 1954

ABSORPTION STUDIES

TRAY EFFICIENCY RESEARCH PROGRAM

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Absorption tests with ammonia and carbon dioxide have been completed with a study of composition gradients and mixing on the trays. A technical report covering this subject will be distributed soon.

At the October 19 meeting of the Research Subcommittee it was agreed that most of the future work at Michigan should be with systems in which the major resistance to transfer is not in the liquid phase. Such a plan will fit best with the work at North Carolina State College, since it is difficult to find any systems for distillation except those in which mass-transfer rates are controlled by resistances in the liquid phase.

Instead of studying next, systems chosen to explore effects of liquid properties on efficiencies, we will then use systems in which liquid phase resistances are negligible. It was agreed that evaporation of liquids into gases—tests similar to air humidification—should be studied. This decision caused a change in the revamping scheduled for November. The equipment was to have been revised to permit stripping and recovery of solutes from liquids. It has been necessary to include a means of removing the vapors from the circulating gases. The repiping period has been lengthened by this addition, but the tower will be in operation again shortly. The start-up may be delayed by the year-end holiday period.

Table I shows the properties of liquids and gases tentatively suggested for the evaporation studies. Molecular size and weight are the only gas properties which can be varied significantly. Helium and nitrogen (or air) are two which can be used easily. Gases of higher molecular weights such as carbon dioxide and freons can be tried also, but the change in diffusivity so obtained will not be too large in relation to the decrease in gas diffusivity from helium to air. The liquids are suggested because they are suitable for later use as the transferring component in absorption or desorption studies where additional resistance is present. It is difficult to find liquids which give a wide variation in properties which affect

transfer rates in the gas phase. Diffusivities of components excepting water, vary only in a two-fold range in any one gas. Larger changes in diffusivities or in Schmidt numbers can be obtained only by changing the carrier gas.

The desirability of determining the relationship between heights and densities of froth and system properties was also discussed at the October 19 meeting. We propose to make such tests on a small static apparatus. Froth densities are apparently functions of gas flow only for a given system and should be easily determined in a simple apparatus. Froth heights are affected by liquid rates as well as the design factors which control liquid gradients on trays. The latter are reasonably well understood. This subject can be discussed at the next subcommittee meeting.

TABLE I
PHYSICAL PROPERTIES OF SOLVENTS

	Vapor Pressure Mm Hg at 20°C	Viscosity Cp at		Diffusivity Dg ft ² /hr in.		Surface Tension Dynes/cm at 20°C
		0°C	25°C	He	Air	
Acetone	186	0.4	0.32	1.2	0.32	23.7
Methanol	100	0.8	0.55	1.9	0.51	22.6
Benzene	80	0.9	0.6	1.1	0.3	29.0
Ethyl Acetate	73	0.6	0.4	1.1	0.3	23.9
Methyl-Ethyl Ketone	71	0.5	0.4	1.0	0.25	24.6
Ethanol	43	1.8	1.1	1.4	0.4	22.3
Heptane	35	0.5	0.4	0.8	0.2	20.0
Water	17.5	1.8	0.9	2.9	0.85	72.8
Methyl- <i>i</i> -Butyl Ketone	15.2	0.8	0.65	0.9	0.2	22.7
N-Butanol	5	5.2	2.6	1.0	0.27	24.6
MIK with Meth-o-cel						

1-100

