

CONTINUOUS ANALYZER FOR SULFURIC ACID ALKYLATION PLANTS

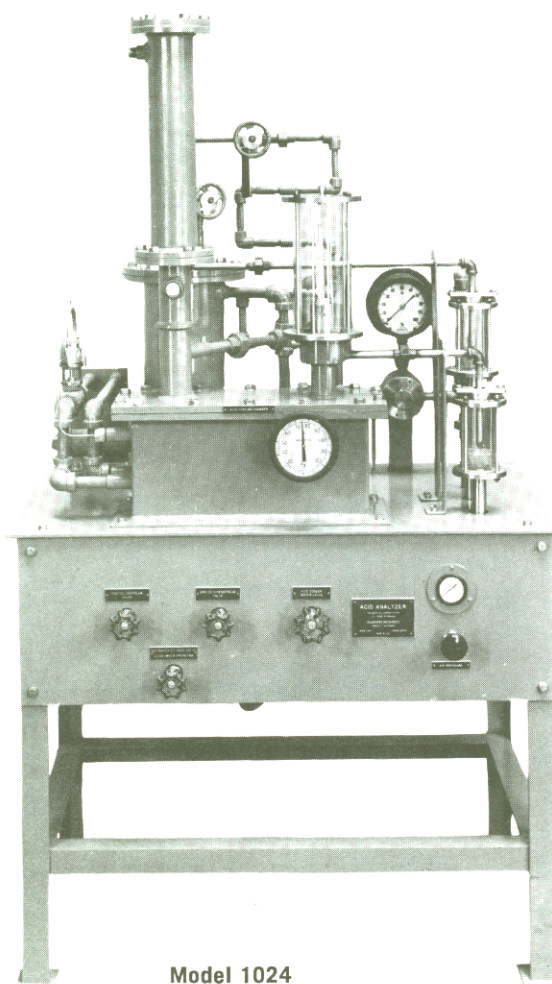
Model 1024

Alkylation plants are using large quantities of sulfuric acid in the production of the ever increasing volume of high octane fuels. Economically it is imperative that acid consumption at these plants be held to a minimum. An important means by which a reduction in acid usage can be accomplished is through knowledge of the acid strength in the reactor at all times. Continuous acid strength measurement permits smooth control and allows the content of acid in the reject to be lower than otherwise possible. Without continuous acid strength measurement, it is customary to sample manually the reactor acid at great hazard at intervals varying from two to eight hours and to control the fresh acid additions in accordance with acidity determinations of the sample. Such periodic manual sampling necessitates maintaining the acid strength in the reactor somewhat above the desired minimum in order to provide a factor of safety.

Figure 1 shows a graph of settled spent alkylation acid in degrees Baume versus percent by weight of titratable acidity.

Figure 2 shows a flow diagram of one design of the acid analyzer for the continuous acid strength measurement of the reactor acid. Acid is continuously withdrawn from the reactor primary settler recycle acid line at a rate of about one gallon per hour. After leaving the acid recycle line, the acid flows through a small diameter pipe, a remote flow control acid valve, a series of restrictors, and on into the heater. The restrictors are used to reduce the pressure drop across the air loaded flow control valve to produce a smoother acid flow. The pressure gauge on the down stream side of the flow control valve indicates an approximate rate of flow of the acid.

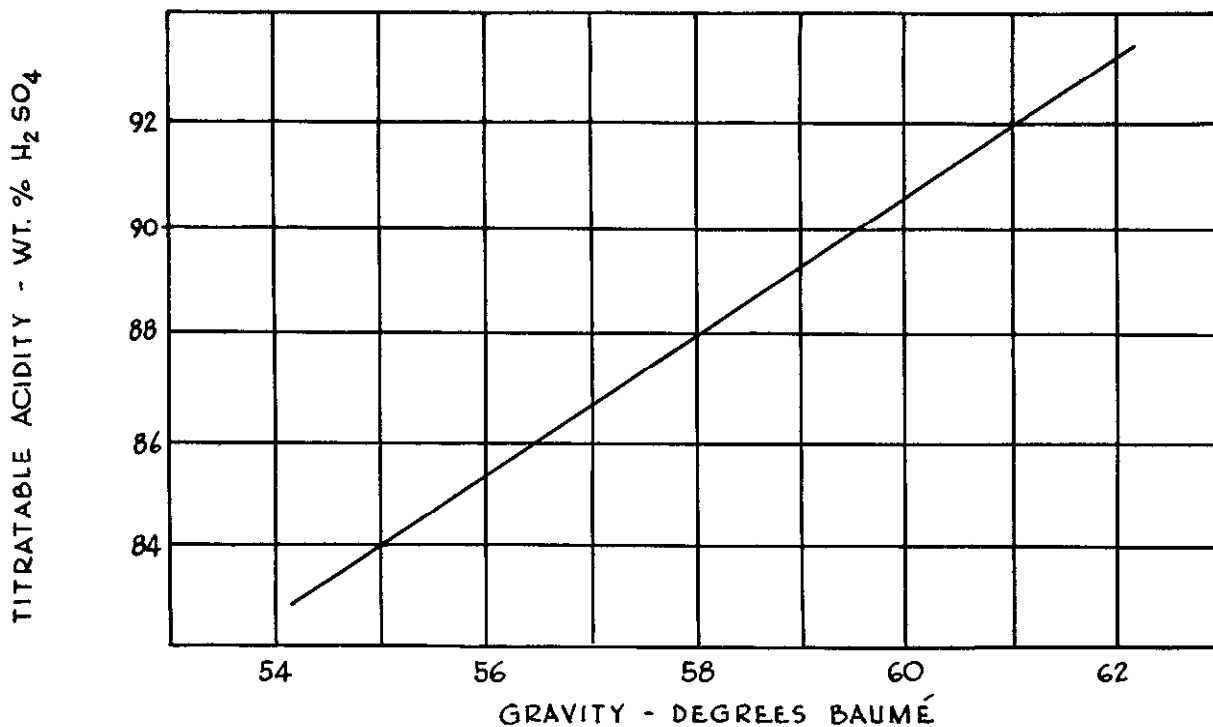
In the heater, the acid and hydrocarbons pass through a coil and are heated. The heat input to the acid in one method is automatically regulated by a temperature controller with the bulb located in the water inlet to the heat exchanger. The temperature of the warm water entering the heat exchanger is the result of a stream of hot water, with its rate fixed by a restriction orifice, being mixed with a



controlled quantity of cold water whose rate is fixed by a temperature controller. The temperature controller with a separable socket and a diaphragm control valve for the cold water line, are not supplied with the analyzer but they can be furnished at extra cost.

A later version of the analyzer substitutes electric heating for the hot and cold water mixture. The electric heater is controlled by a thermostat. The heat exchanger in this case is usually filled with oil. A more recent version of the analyzer uses an electric heating feature but eliminates the acid cooler, hydrometer sight glass, alkylate and acid sight glass and substitutes an automatic density measuring device which also includes temperature compensation. The automatic density device normally provides a signal for connection to a recorder or recorder controller mounted in control room.

The warm acid and hydrocarbons, after leaving the heater, flow to the degasifying chamber where the liquid hydrocarbons and acid drop into a distributing cup while vaporized light hydrocarbons are vented from the system. The liquid runs through holes in the bottom of the distributing cup over Raschig rings contained in a perforated basket which is supported coaxially by the degasifier, thus providing an annular space between the inside chamber walls and the basket for removal of vapors. As the acid spreads out over the Raschig rings, any remaining light hydrocarbons, alkylate and acid flow into the alkylate separating chamber where the alkylate is skimmed from the acid and leaves the system by way of the sight flow indicator. The quantity of alkylate is small and therefore is not a handling problem. A temperature of 105°F. in the alkylate separating chamber has been found suitable for removing alkylates, etc.



Typical Relation Between Settled Alkylation Acid Strength and Baumé Gravity

FIGURE 1

The warm, light hydrocarbons and alkylate-free acid flow out the bottom of the alkylate separator, through a water cooler and into the bottom of the hydrometer jar. The cooled acid then passes up around the floating hydrometer, overflowing at the top of the hydrometer jar into a circular trough, through a sight flow indicator and then to a blow case for acid recovery.

The apparatus has a process lag of about ten minutes from the time the acid leaves the reactor acid recycle line to the moment its strength is indicated by the hydrometer. The trend of an acid strength change in the reactor is apparent to the operator any time that the reading of the hydrometer is observed.

The analyzer must be water washed about once a month to keep it in good condition. This is accomplished by flushing the entire analyzer system with water for a period of five minutes. During the washing procedure, the acid and water leaving the hydrometer jar are diverted to the sewer.

All equipment is totally enclosed for personnel safety. The hydrometer and alkylate sight flow indicator, as well as the acid sight flow indicator, are enclosed in heavy glass bowls for easy and frequent observation. The apparatus is comparatively small, measuring overall 24" wide x 40" long x 69" high. All piping connections are on the back of the unit.

Those parts that come in contact with the hot sulfuric acid are constructed of Hastelloy B. This portion is from the heater coil to the circular trough around the hydrometer vessel. All connections are welded with Hastelloy B welding rod. The flow control valve has a Hastelloy B seat, plug and stem.

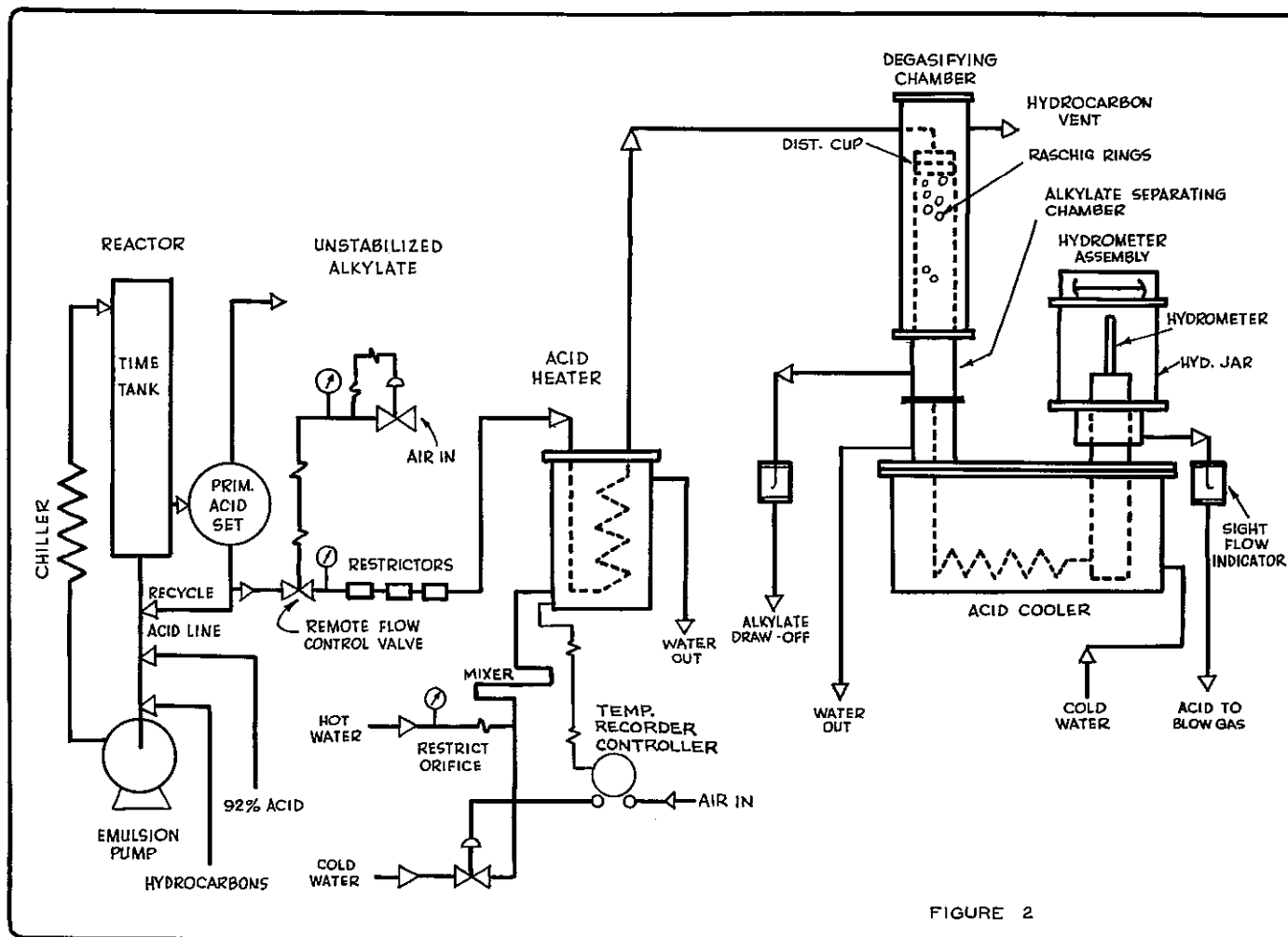


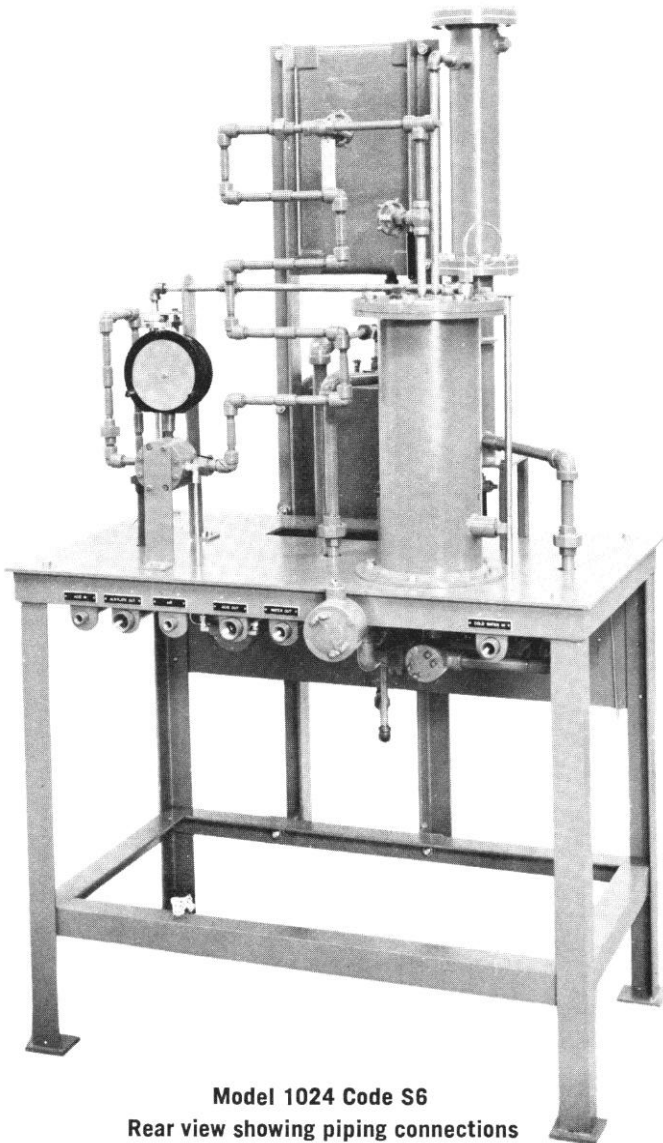
FIGURE 2

REPRODUCIBILITY

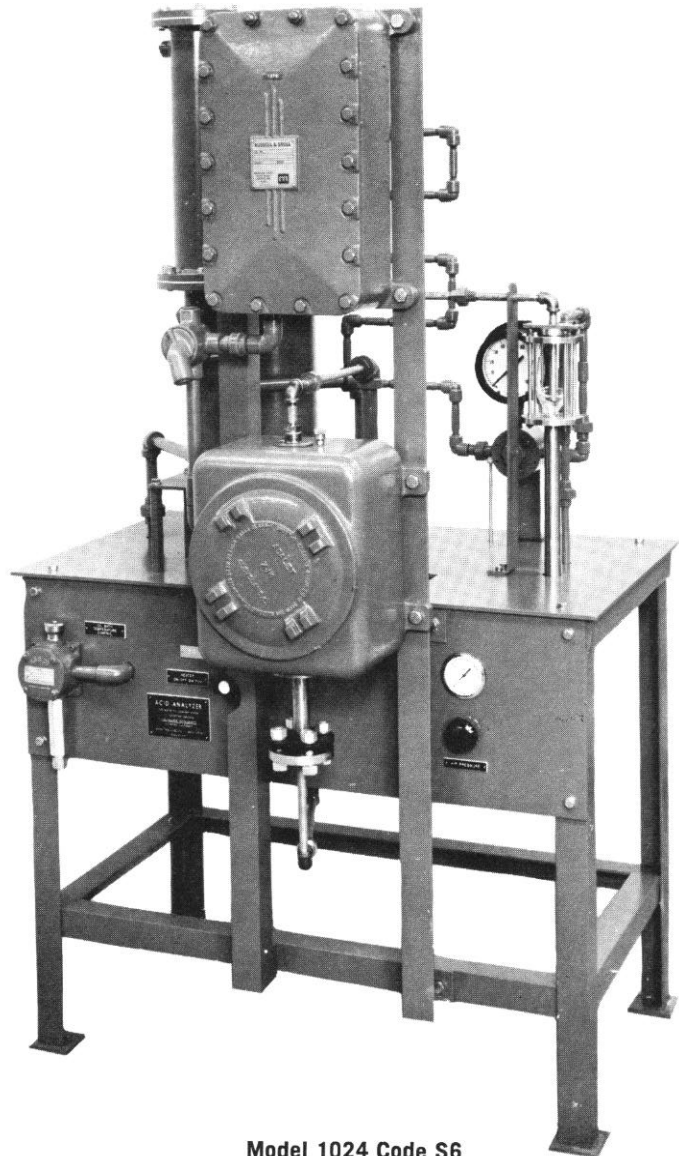
If a sample of the spent acid from the analyzer is centrifuged from 10/20 minutes and then titrated with NaOH solution, the correlation between percent acid strength and gravity should be better than ± 0.1 Baume.

MODELS

- Model 1024 — Standard unit using hot and cold water mixture.
- Model 1024, Code S3 — Standard unit with electrical heating.
- Model 1024, Code S6 — Unit incorporating electrical heating and automatic readout using Densitrol.



Model 1024 Code S6
Rear view showing piping connections



Model 1024 Code S6