Phenolphthalein Kinetics

**TO: Engineering Development Branch**

**FROM: Engineering Division**

**SUBJECT: Phenolphthalein Kinetics**

In several reactors in the Baytown plant, the internal volume is not known accurately due to installation of new baffles and heat exchange equipment. We need to measure the internal volume and the reactor space-time (or residence time). It is proposed to use the phenolphthalein reaction with hydroxide ion to measure the residence time.

The reaction of phenolphthalein with a base solution follows the 2-reaction sequence given below.

Ph + 2OH− → Ph2− + 2H2O Reaction 1

Ph2− + OH− ⇔ PhOH3- Reaction 2

Reaction 1 is very fast and can be assumed to be instantaneous.

Phenolphthalein could act as an indicator to determine the residence time of several large CSTR reactors in the pilot plant (see Fogler, Chapters 13-14). Your assignment is to determine the kinetic parameters for Reaction 2 with respect to phenolphthalein fading in sodium hydroxide in the temperature range of 60 – 120 °F. In addition to the rate constants, determine the heat of reaction and the equilibrium constant. We have an absorbance spectrometer that you can use to determine the residence time, and you can use this in your experiments. Finally, indicate a procedure and an equation that can be used to estimate the average reactor residence time based on measured inlet and outlet phenolphthalein absorbances and your measured kinetic parameters. Recommend a temperature at which we should make the measurements on the large CSTR reactors.

References:

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