EFFECT OF CONTACT SURFACE.

The factor of contact surface is of secondary importance in the processes under consideration, except as it may be associated with catalytic effects. This factor is of importance, however, in liquid-phase cracking processes, as in them much of the cracking is due to local superheating of oil in contact with the walls of the container. The higher temperatures possible in the vapor phase bring about the same acceleration in reaction velocity that is accomplished by the use of catalyzers.

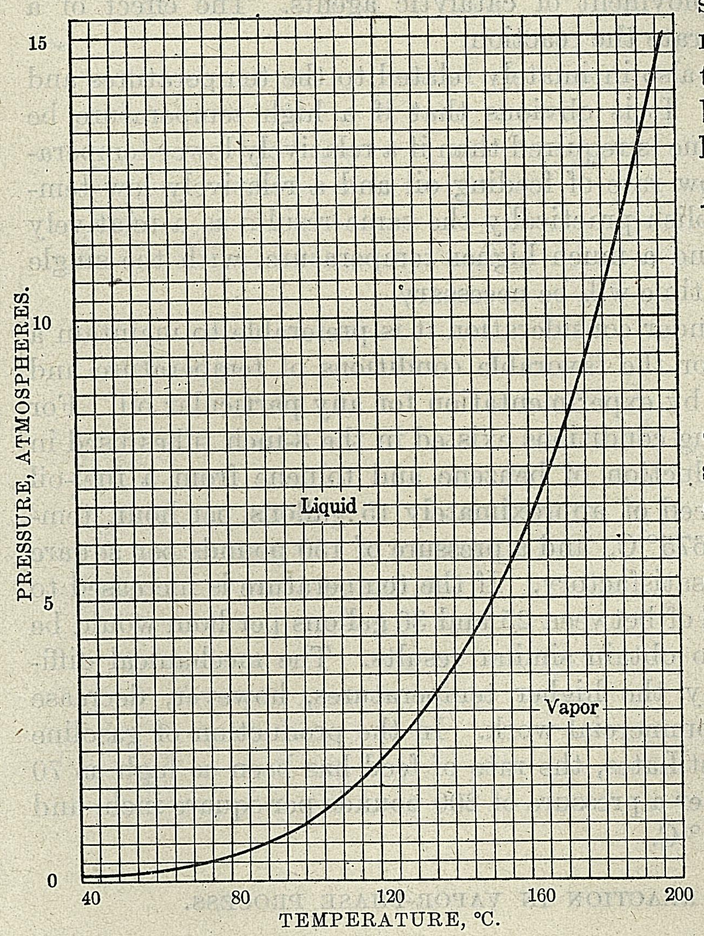

FIGURE 8.—Vapor-pressure curve for water.

ADVANTAGES OF SINGLE-PHASE CRACKING PROCESS OVER TWO-PHASE PROCESSES.

The advantages of the one-phase system become evident on consideration of some principles of physical chemistry. In a two-phase system temperature and pressure are functions of each other; in a one-phase system they are mutually independent. The simple vapor-pressure curve for water shown in figure 8 makes this clear. If liquid and vapor are both present equilibrium is represented by a line, and any deviation from the combination of conditions indicated by this line results in the disappearance of a phase. Thus if water is heated to a temperature higher than 100° C. under atmospheric pressure it is entirely changed into vapor. But water vapor will remain as such under any desired condition of temperature and pressure within the limits that do not cause condensation of liquid.

Of course, petroleum is not exactly comparable with water, as petroleum is not a single compound but a complex mixture. A certain limited degree of flexibility of control of the two variables, temperature and pressure, is possible even in a two-phase petroleum system, as equilibrium is maintained by changes in the relative composition of gaseous and liquid phases. But beyond a certain point there is no flexibility, and, in actual fact, cracking conditions in all two-phase processes are in large degree controlled by the nature of the oil used as original material.

A possible objection to the vapor-phase processes herein discussed might be that when these processes are applied to an oil with constituents having boiling points as high as 550° C., and the temperature in the tube, for example, 500° C., all the hydrocarbons are not vaporized. However, all the oil acted on is in the gaseous phase. Any heavier ungasified hydrocarbons will fall instantly out of the sphere of reaction. The cracking tubes are vertical and the force of gravitation attends to any deficiencies in temperature. However, when high-boiling residues are being treated it is perfectly practicable to increase correspondingly the temperature in the tube. When the hydrocarbons under treatment boil at a temperature below that of the tube there is little difficulty in obtaining complete vaporization, provided a suitable rate of flow is maintained. Moreover, as the processes are so arranged that cracking takes place in the gaseous phase, the temperature and the pressure may be controlled independently.

As pressure and temperature are the two most important chemical factors involved in any gaseous chemical process, the importance of being able to change either one of these variables at will without varying the other is readily seen. Moreover, the mode of treatment used in the processes herein described is in no way limited to the petroleum industry. Any reactions possible between substances capable of vaporization may be conducted in a single (gaseous) phase. Such a procedure has two decided advantages, as follows:

1. The high speed of reaction incident to high temperatures.
2. Thorough mixing and contact.

It is believed that the time will soon come when it will be found advantageous to conduct in the gaseous phase many reactions that now take place in the liquid phase.

OBJECTIONS TO USE OF TUBES.

A characteristic feature of many cracking processes is the use of tubes of various lengths, sizes, and arrangements in place of the conventional still. The following objections are typical of those generally raised:

If large tubes are used, it is claimed that there is a tendency to short circuiting or channeling, much of the original material being thus permitted to pass through without attaining the desired temperature. Attempts to apply higher temperatures result in uneven