

In view of the widely varying percentages of the different aromatic hydrocarbons obtainable from a crude oil, and in view of the course of reactions among aromatic hydrocarbons, a most significant feature is that there are present in the tars resulting from most present-day distillations of coal a small percentage of low-boiling aromatic hydrocarbons, such as benzene and toluene, and a very large percentage of aromatic hydrocarbons of large molecular weight such as naphthalene and anthracene. The latter undoubtedly are formed in some stage of the operation from monocyclic aromatic hydrocarbons. In practically all coal tars there is less than one part of toluene to three parts benzene. It is furthermore common information that naphthalene, methyl-naphthalenes, methyl-anthracenes, anthracenes, etc., are present in large proportions. In the light of the investigations reported, which unquestionably indicate the course of reaction to be first in the formation of the higher members of the benzene series, then progressively to the formation of toluene, benzene, naphthalene, anthracene, carbon, and gas, it is to be concluded that practically every present coal-distillation process carries the cracking to the point of ruinous decomposition of benzene and toluene in the formation of the higher boiling aromatics. The Bureau of Mines is at present investigating this feature.

PART II.—DESCRIPTION OF LARGE-SCALE DEVELOPMENT OF BENZENE-TOLUENE AND GASOLINE PROCESSES.

PURPOSE OF EXPERIMENTS.

In connection with the description of and comment on the large-scale development of the benzene-toluene process which follows, it should be kept in mind that the object in view was to demonstrate the commercial feasibility of the process. Certain refinements in mechanical equipment were out of the question at the outset for two reasons. The first was that such devices were not suited to minute study of each step in the process; the second was that they could be installed at any time after the commercial possibilities of the process had been demonstrated. For instance, such obvious improvements as feeding the oil by a single pump through a common header, or the use of one large condenser for all the tubes in place of individual condensers for each tube, were set aside in favor of less desirable mechanical arrangements by which each tube could be kept as a separate unit and its products analyzed apart from those of the remaining tubes.

As regards the condenser installations described herein, it must be borne in mind that these were not intended for continuous operation, 24 hours a day, as their capacity was limited to runs of 4 to 5 hours' duration. For short runs they served the purpose admirably and made possible the analysis and study of the products from each tube, but for long runs their efficiency was low. The recovered oil often left the condensers at the end of a run of considerable duration at a temperature higher than the boiling point of benzene and toluene. This high temperature naturally caused heavy evaporation losses and is responsible for the relatively low and inconsistent yields which are reported for the period of purely experimental development covered by this bulletin. It can safely be stated that the total yield of low-boiling aromatic hydrocarbons reported could have been doubled by the installation of an adequate condensing system supplemented by apparatus for washing or scrubbing the uncondensed gases.

It will readily be recognized that it was first necessary to prove that the process would work as well on a commercial basis as in the laboratory. This could be done only at the sacrifice of a very considerable percentage of the product formed. Elimination of this loss was regarded as a mere matter of course, to be taken up at will.