ABNORMAL DEMAND FOR BENZENE AND TOLUENE DURING 1915.

Due to the European war, the demand for benzene and toluene for making explosives has been so great during 1915 as to cause the prices for these hydrocarbons to increase enormously. Toluene, for example, which normally could be bought for less than 25 cents a gallon has netted as high as $8 and $9 a gallon. Benzene, which under ordinary conditions is worth 15 cents a gallon, has brought as high as $1.50 a gallon.

Although the potential production of the aromatic hydrocarbons from coal is sufficient to satisfy the probable demand of the country for years to come, the requisite plants have not yet been built, and necessarily some time must elapse before they can be. By-product coke ovens are expensive and although the profits to be derived from them are considerable, it is probable that the primary cost of construction will make the extension of the number of such plants a matter of progressive growth only. The fact that aromatic hydrocarbons are recovered from coal tars and coke-oven gases purely as by-products makes it improbable that petroleum can compete successfully as a permanent source of supply. The advantage in the use of petroleum lies in the fact that much greater yields can be obtained per unit of original material. Where 1 per cent by weight of light oils can be obtained from coal gas and 0.1 and 0.2 per cent from coal tar on the basis of original coal, petroleum has been proven to yield 12 to 15 per cent and more of the lower boiling aromatic hydrocarbons on the basis of original volume. For example, 100 gallons of oil, worth 3 to 5 cents a gallon, will produce 6 gallons of benzene, 6 gallons of toluene, 2½ gallons of xylene, and smaller quantities of naphthalene and anthracene. Two tons of coal, worth approximately the same amount, will produce 0.7 gallon of toluene, 3 gallons of benzene, and 0.35 gallon of xylene.[a]

The much smaller cost of a plant producing aromatic hydrocarbons from petroleum as compared with the cost of a by-product plant, gives petroleum a considerable advantage as a source of supply for these materials, especially when there is an excessive demand for these products.

The demand for trinitrotoluene by the warring European powers has caused the price of toluene in the United States to soar, although only a small percentage of the trinitrotoluene used has come from this country. It is evident, therefore, that the by-product coke-oven installations and carbureted water-gas plants would to-day be incapable of supplying the toluene that would be needed if our Nation should be called on to go to war. This dearth of supply would continue to

[a] Puning, Franz, Benzol, how it is recovered from coal gas: Iron Trade Rev., vol. 53, 1913, pp. 625-632, 653; Wagner, F. H., Coal-gas residuals, 1914, p. 123.

exist without such a process as that described herein, as by-product plants could not be constructed quickly enough to meet the Nation's needs. Therefore, the successful large-scale development of such process is a source of national security, as in view of our extensive petroleum resources, the United States could be independent of the world for our supplies of the aromatic bases for the most efficient military explosives.

EARLY EFFORTS TO OBTAIN AROMATIC HYDROCARBONS FROM PETROLEUM.

It has long been known that aromatic hydrocarbons could be obtained from petroleum. As early as 1877, according to Veith,[a] Letny[b] obtained a patent for producing aromatic hydrocarbons from petroleum and on that account is regarded as the first experimentor to obtain these products from that source. After Letny, Liebermann and Burg,[c] Salzmann and Wichelhaus,[d] and Lissenko[e] investigated the obtaining of aromatic hydrocarbons from petroleum residues at high temperatures.[f]

The presence of benzene and its homologues in crude petroleum was established at an early date. Prior to 1880 La Rue and Miller had obtained evidence of their presence in a number of crude oils.[g] Benzene has been found in Galician distillates by Pawlewski,[h] Lachowicz,[i] and others; in Baku crude oil by Markownikoff,[j] in crude oil from Tiflis by Beilstein and Kurbatoff; in Rangoon oil by La Rue and Miller, in Roumanian oil by Poui,[k] and in Canadian crude by Schorlemmer. Toluene was also found in the same oils by the same investigators. The proportions of these aromatics in crude oils are, however, small, being only fractions of a per cent. For example, Pawlewski reports having found 0.4 per cent in Galician

[a] Veith, Alexander, Gewinnung aromatischer Körper aus den Rückständen: (Bolley and Wiedemann, Handbuch der chemsche Technologie Erdöl) 1862, p. 435; See also Letny, Alexander, Ueber die Einwirkung hoher Temperatur auf Petroleum, Braunkohlentheer und andere ähnliche Stoffe: Dingl. poly. Jour., Bd. 229, 1878, pp. 353-365.

[b] Letny, Alexander, Ueber die Zersetzung des Petroleums und des Braunkohlentheers durch Ueberhitzen: Ber. Deut. chem. Gesell., Jahrg. 11, 1878, pp. 1210-1212; Decomposition of petroleum and lignite tar by superheating: Chem. News, vol. 38, 1878, p. 211.

[c] Liebermann, C., and Burg, O., Ueber die Zersetzung des Braunkohlentheeröls in der Glühhitze: Ber. Deut. chem. Gesell., Jahrg. 11, 1878, pp. 723-726.

[d] Salzmann, M., and Wichelhaus, H., Ueber die Herstellung von Benzol aus Braunkohlentheeröl: Ber. Deut. chem. Gesell., Jahrg. 11, 1878, pp. 802, 1431-1434.

[e] Lissenko, K., Zersetzung des Erdöles beim Erhitzen: Dingl. poly. Jour., Bd. 266, 1887, p. 226.

[f] See Beilstein, F. K., On formation of benzene when petroleum is passed through a hot tube: Handbuch der organ. Chemie, Auflag. 3, Bd. 2, 1896, p. 22.

[g] Petroleum: Encyc. of Chemistry, Lippincott, 1880.

[h] Pawlewski, B., Ueber das Vorkommen des Paraxylols im galizischen Petroleum: Ber. deut. chem. Gesell., Jahrg. 18, 1885, pp. 1915, 1916.

[i] Lachowicz, B., Ueber die Bestandtheile des galizischen Petroleums: Liebig's Annalen, Bd. 220, 1883, pp. 188-206.

[j] Markownikoff, W., and Spady, J., Zur Konstitution der Kohlenwasserstoffe $C_n H_{2n}$ des kaukassischen Petroleums: Ber. Deut. chem. Gesell., Jahrg. 20, Bd. 2, 1887, pp. 1850-1853.

[k] Poui, P., Récherches sur la composition chemique des petroles roumains: Ann. Sci. Univ., t. 2, 1903, pp. 65-80.