determining its strength is to convert a known weight into anthra­quinone, C14H10O2, by boiling it with a glacial acetic acid solution of chromic acid, separating out the quinone by diluting with water, collecting and weighing the product. One part of quinone corre­sponds to 0∙8558 of anthracene.

*Creosote Oil* is either used as it is for pickling timber, softening of pitch, &c., or else redistilled to extract from it what there is of anthracene oil and carbolic acid oil, which are worked up with the respective principal quantities.

*Carbolic Oil.—*Assuming this oil to have been collected (as it should be if intended for the making of carbolic acid) between 170° and 230o, the process of extraction is, briefly, as follows. The oil is mixed with a suitable proportion of caustic-soda ley (ascertained by an assay) in an iron vessel at 40° to 50° C. Charles Lowe recommends ley of 1∙34 sp. gr., diluted with water to five times its volume. After settling, the aqueous layer is withdrawn into a lead-lined vessel, and the soda supersaturated by sulphuric acid. Crude carbolic acid rises to the top as an oil, and is withdrawn to be sold as such or purified. See Carbolic Acid.

*Naphthalene* abounds in the oil left after extraction of the carbolic acid by caustic soda and in the more volatile fractions of the creosote oil. From these it separates out (not completely), on standing, in crystals. These are collected, best in a filter-press, and then subjected to hydraulic pressure to force out the rest of the mother-liquor. The crude naphthalene thus obtained contains an impurity which causes it to become red on standing in the air. To remove it, the crude product is mixed with 5 to 10 per cent. of vitriol of at least 1∙7 sp. gr., at a moderate heat (addition of a little binoxide of manganese is an improvement, Lunge) ; it is then washed, first with water, then with dilute alkali, and lastly again with water, to be ultimately distilled or sublimed. In the latter case it is obtained in the form of thin colourless plates of great beauty. It fuses at 80° C. and boils at 217° C. Naphthalene is used largely in the making of certain tar colours, such as Manchester yellow, C10H6(NO2)2, and the beautiful scarlets and crimsons made by the “farbwerke” in Höchst, Germany; these latter are diazo­compounds derived from ß-naphthol, C10H7(OH). Coal gas, if impregnated at a suitable temperature with naphthalene vapour immediately before issuing from the burner, gains greatly in lumin­osity. This is the principle of the “ albo-carbon ” gas lamps.

*First Runnings and Light Oil.—*These may be said to include all the industrially valuable “benzols” (taking “benzol” as a generic term for benzol or benzene itself and its higher homologues, C6H6, C7H8, C8H10, &c.). As the distiller in most cases does not aim at an actual separation of all the individual benzols from one another, but at the production of certain benzol mixtures demanded by the trade, the mode of working may assume a great variety of forms ; yet the first aim in all cases is the same, being the elimina­tion of all the non-benzol from the given oil or oils. For this purpose the light oil is, as a rule, subjected to a preliminary fraction­ation over a naked fire to split it up into fractions fit to be worked for (crude) benzol (C6H6 and C7H8), for carbolic acid (C6H6O), and to be incorporated with the creosote oil respectively ; the carbolic acid is extracted, and the creosote-oil part put aside, and thus one or more mixtures of “ benzols ” are obtained.

The first runnings contain the bulk of the benzene, C6H6, and a little of its higher homologues, associated, however, with bisulphide of carbon, low-boiling olefines, CnH2n, traces of carbolic acid, &c. To remove these impurities as far as possible, the oil is thoroughly agitated with concentrated oil of vitriol (which takes up the impurities except the bisulphide of carbon), and the “dirty” acid allowed to settle out. The acid is then withdrawn as neatly as possible, and the residual oil washed, first with water, then with dilute caustic soda, and, lastly, again with pure water. The washed oil then is subjected to a preliminary fractionation by distillation over a naked flame in the “ crude benzol still.”

The’ several mixed benzols obtained are subjected finally to a further fractionation in stills worked with steam, to be divided into mixed products known by specific names in commerce. But these we cannot possibly consider here. We will rather give an idea of the way in which the several chemical species (benzene, toluene, &c.) are being isolated in a state of approximate purity to meet the demands of the tar-colour industry. To do so even for one named component by means of ordinary stills would require an endless number of fractional distillations. The work is very materially shortened if, as proposed by Mansfield long ago, we combine the still with an inverted condenser (still-head, dephlegma­tor), inserted between the still and the worm, and keep that inter­mediate condenser at a suitable constant temperature, so that all the less volatile part of the vapour is recondensed and sent back to the still. An excellent apparatus of this kind was constructed and worked successfully by Coupler. His apparatus consists of three parts, viz.:—(1) a still heated by means of a coil of close steam pipes ; (2) a columnar rectifier—“ colonnen-apparat ” as the Germans call it,—which communicates with the still, and which is divided into many compartments by horizontal septa so contrived that the vapour in passing from a compartment to the next higher one must bubble through the liquid condensed there from preceding vapour,—an overflow pipe, trapped below by condensate, hindering accumulation of the liquid in any compartment beyond a certain level ; (3) a constant temperature still-head, consisting of a succes­sion of communicating ring-shaped tubes, which are immersed in a bath of water or molten paraffin kept at a prescribed constant temperature. Only the most volatile part of the vapour survives as such in the columnar rectifier, the degree of its volatility depending, of course, other things being equal, on the rate at which we distil. This most volatile part suffers partial condensation at the prescribed temperature in the still-head ; the condensed parts are sent back to compartments of the “column” by pipes bent into the shape of a U at the point where they join the “column,” so as to prevent vapour from entering them. The uncondensed vapour goes to the worm, and is condensed as usual.

To prepare benzene, the still-head is kept at 60o to 70o C. At first a mixture of low-boiling bodies and benzene goes over, which is rejected, but soon pure benzol follows and continues until almost all this component has distilled over. The benzol obtained boils between 80° and 82° C., and consequently is practically pure. In order now to extract the toluene, C7H8, we raise the temperature of the still-head to 100° C. A small quantity of a mixture of benzene and toluene follows, which is rejected. After it comes a continuous distillation of almost pure toluene, boiling at 110° to 112° C. In a similar manner (relatively) pure xylene, C8H10, boiling point 137° to 140°, and tri-methyl-benzene, C9H12, boiling point 148° to 150°, can be extracted successively ; but the process becomes troublesome with anything above toluene on account of the high temperatures involved for still and still-head. Coupier’s apparatus is now super­seded by other constructions, but they all work on the same prin­ciple,—that of the Coffey still, as used for the rectifying of spirit of wine.

Pure benzene, toluene, and xylene are used largely for the manu­facture of tar-colours. The following (and other) mixtures are pro­duced directly from the light oil or first runnings :—

|  |  |  |  |
| --- | --- | --- | --- |
| (1) 90 per cent. benzol | initial boiling point | 82’ | C. |
| (2) 50 per cent. benzol | " | 88 |  |
| (3) “Toluol” | " | 100 |  |
| (4) Carburetting naphtha | ,, ,, | 108 |  |
| (5) Solvent naphtha |  | 110 |  |
| (6) Burning naphtha | *,,* | 138 |  |

No. 4 serves for enriching coal-gas and adding to its luminiferous power, No. 5 for varnishes, No. 6 for feeding primitive lamps used in the open air, where smoke is no objection.

The following percentage table for the tar from the Berlin gas­works (given in *Chemische Industrie* for 1879) gives an idea of the quantitative composition of this most complex material :—

|  |  |  |
| --- | --- | --- |
| Benzol (including toluol, &c.) | 0∙80 |  |
| Higher benzols | 0∙60 |  |
| Crystallized carbolic acid | 0∙20 |  |
| Cresol for disinfecting purposes | 0∙30 |  |
| Naphthalene | 3∙70 |  |
| Creosote oil |  | 24∙00 |
| Anthracene (pure) |  | 0∙20 |
| Pitch |  | 55∙00 |
| Water and loss |  | 15∙20 |

TARAI, a British district in the Kumáun division of the lieutenant-governorship of the North-West Provinces and Oudh, India, lying between 28o 51' and 29o 30' N. lat. and 78o 46' and 79o 47' E. long. It contains an area of 938 square miles, and is bounded on the N. by the Khumáun Bhábar, on the E. by Nepál and Pilibhit sub­division of Bareilly district, on the S. by the districts of Bareilly and Moradábád and the native state of Rámpur, and on the W. by Bijnaur. The headquarters of the dis­trict are at Naini Tal. Tarai (“ moist land”) consists of a long narrow strip of country running for about 90 miles east and west along the foot of the Himalayas, with an average breadth of about 12 miles. At its northern edge, where the waterless forest tract of the Bhábar ends, a series of springs burst from the surface, and these, in­creasing and uniting in their progress, form the numerous streams that intersect the Tarai. The Deoha is the great river of the Tarai proper, and is navigable at Pilibhit. Elephants, tigers, bears, leopards, hyænas, and other wild animals are found in the district. The climate is normally bad, but improvement is gradually following the spread of sanitary measures.

According to the census of 1881 the population was 206,993 (113,315 males and 93,678 females). Hindus numbered 131,966 and Mohammedans 74,982. The only town with a population exceeding 10,000 is Kásipur, with 14,667 inhabitants. The whole tendency of the population is to agricultural and not to urban life.