

"After leaving the boiler and immediately before being put on the road, an equal quantity of fine shore sand heated to 400° F. shall be added to the pitch mixture, which shall then be kept continually stirred until spread.

"The macadam shall be of durable granite or trap rock from the quarries of North Wales or from other approved quarries having a similar class of rock. It shall be carefully broken into cubical form so as to be capable of passing through the specified gauge in any direction. It shall be cleanly riddled to free it from dust and all flat slaty fragments shall be picked out before shipment.

"2½-inch macadam shall pass through a 2½-inch ring and be held by a 2-inch ring.

"1½-inch macadam shall pass through a 1½-inch ring and be held by a 1-inch ring.

"The pitch shall yield no matter volatile below 270° C. when subjected to dry distillation, and its total volatile organic matter shall not fall below 30 per cent.

"It shall not contain more than 80 per cent. of its weight of matter insoluble in petroleum spirit of 0.700 specific gravity (boiling) and must be free from extraneous matter, such as sand and grit.

"It must twist fairly after immersion for two minutes in water at 60° C. but not under 550° C. (Hereinafter referred to as Clause 3.)

"The oil supplied shall be obtained exclusively by the distillation of coal tar, and shall not contain any portion of the distillate obtained below 240° C. None of it shall re-distil below 240° C.

"The oil as obtained by distillation of coal tar shall not be treated in any way, either by the addition of any coal tar product, or by the extraction of any of its constituents, excepting such extraction as may be necessary to comply with clause 3. It shall contain no moisture. It shall contain no solid matter at 15° and shall have a specific gravity of not less than 1.075 (taking water as 1.00 at 15° C.).

"It shall contain not less than 40 per cent. of its constituents that do not distil over below 320° C. and the 60 per cent. which does distil over below 320° C. shall contain 10 per cent. of tar acids, to be extracted by soda of specific gravity 1.125 (water 1.00)."

The Massachusetts Type.—The three Massachusetts bituminous sand-grout pavements have been constructed by A. W. Dean, chief engineer, and F. C. Pillsbury, division engineer of the Massachusetts Highway Commission, Boston, Mass. The Tyngsboro Road was laid in May, 1914; the Wayland and Natick roads in August, 1914.

The ordinary methods of heating and drying the sand were found satisfactory; the heaters, in fact, being home-made. Some of them were old corrugated metal culverts, 1½ ft. in diameter and about 12 ft. long; others were old, iron smoke stacks, about 18 ins. diameter and of varying lengths; still others were old boiler plates. Three or four of these heaters were used simultaneously, being laid parallel to each other. They were moved from time to time in order to have the hot sand near to the point of distribution, so that it could be moved in wheelbarrows from the heaters.

A small shallow trough was used for mixing the sand and tar. This trough was about 4 ft. long, 3 ft. wide and 1½ ft. deep. It has vertical ends, but otherwise was curved like half of a circular cylinder. In other words, it was approximately the shape of half of a barrel that had been split longitudinally. The sand used was very fine and clean, the fineness being required to provide for the suspension in the tar when pouring. The tar was brought to the road in tank wagons, fitted with steam

coils. A steam road roller moved the tank wagons during distribution, and also provided steam for heating the coils.

The mixing trough, on a truck with small wheels, was attached immediately behind the tank wagon, and so close that the hot tar could flow from the tank wagon into the trough. The hot sand was brought up from the roadside and measured into the trough, and two laborers on each side mixed the tar and sand in approximately equal proportions, with the aid of pieces of hose. In the rear of the trough was a pipe outlet and a valve through which the mixed tar and sand were let into pouring pots. The usual flat-nozzled pouring pot was used.

Great care was taken in pouring, it being done immediately after mixing, and longitudinally with the road. It was found better to have only one man to do the actual pouring all the time, the pouring pots being carried to him from the mixing trough. This man acquired great skill in pouring and obtained uniform results in the quantity applied.

The broken stone was not less than 1½ ins. and up to about 2½ ins. to 3 ins., effort being made to secure stone as uniform as possible. The thickness after rolling was from 2 ins. to 3 ins., as desired. Before pouring, the stone was rolled sufficiently to prevent it from being rutted by wagon wheels. A fairly safe rule for the quantity of mixture was found to be, one gallon of mixture per inch of thickness in stone. Immediately after pouring, a thin covering of peastone was spread, sufficient in quantity to permit rolling without the roller sticking to the tar. After a thorough rolling, the surplus peastone was swept off, and an application of tar spread uniformly, preferably from a pressure distributor, and at the rate of about half a gallon per square yard. This, in turn, was covered with peastone or chips and thoroughly rolled.

The base, or bottom course of stone, was well drained, and before the top course was spread it was rolled thoroughly, and bound with stone screenings, fine screened gravel or sand. This was not only to preserve its shape during future operations, but also to prevent the escape of the tar-sand down into the bottom course.

A portion of the 300-ft. section that was laid with asphalt, was laid with material of about 140 penetration, the remainder being laid with asphalt of about 45 penetration. It was decided that the penetration should probably be about 100, although the stiffness of the asphalt might be increased according to the weight of traffic. This would also depend somewhat upon the type of asphalt used. The temperature to which the asphalt should be heated would vary according to the stiffness of the asphalt, but in any case should not be so high that it would be much hotter than the sand, as otherwise the mixture would likely foam. It was found that 300° F. was usually about the proper heat.

The Massachusetts engineers state that the cost of the bituminous sand-grout pavement should not be more than ten cents per square yard greater than the cost of the usual penetration type of road. The Massachusetts work, where costs were kept, was not over eight cents in excess of penetration work, and one job ran as low as six cents additional.

SHIPBUILDING ACTIVITY IN DENMARK.

The Copenhagen Floating Dock and Shipbuilding Company has secured a site of 70,000 sq. m. for extending the works; for this purpose the capital is being increased by 1,000,000 kronen, to 3,000,000 kronen. (1 krone = 27c.)