

conducted the usual tests for abrasion, hardness, toughness, absorption, and, in some cases, for crushing-strength. These tests not only served as a check on the quality of aggregates supplied by contractors, but also, in conjunction with geological reports, have been of considerable aid to field engineers in their selection of quarry-sites.

A large number of soil tests was carried out and research continued in regard to base- and top-course materials, subgrade soils, sealing-chips, and concrete aggregates.

As a result of research and experiments, many aggregates and soils which in the past have been looked upon as being unsatisfactory roading-materials can now be treated to provide satisfactory service as subgrades or as metal crusts. Laboratory work often indicates methods of blending and "humouring" by which satisfactory stable aggregates can be produced from what would otherwise be unstable ingredients.

Many districts have been supplied with equipment for testing and analysing materials, and the other districts will be supplied with similar equipment from time to time in order that the routine examination of their local materials can be undertaken. This would leave the central laboratory more freedom to undertake check tests and research work.

An interesting investigation was conducted during the year with the object of developing methods of improving the adhesion between bituminous binders and certain mineral aggregates which in the past have not been satisfactory in this respect. It was found in the case of some aggregates that a thin coating of cement-wash greatly decreased the tendency for sealing-chips to "whip-off" under traffic. Some cheaper method was sought, with the result that a marked improvement in adhesion was often obtained by pretreating the aggregate with a very low percentage of certain light distillates, and, in some cases, satisfactory and still cheaper results were achieved by adding the distillate to the bituminous binder. Further research is being continued in this direction.

In addition to carrying out a large number of routine identification tests of bituminous materials, the Dominion Analyst has conducted during the year other important examinations on behalf of the Board.

A very fine piece of new apparatus by which the ductility of bituminous materials will be determined with the minimum of personal control was recently purchased and is about to be put into operation. It is expected that this machine will play an important role in the examination of sealing-binders. Another interesting and valuable piece of equipment for ascertaining the lability index of emulsions has been built and assembled by the laboratory staff. This will allow of a number of determinations at the one time and will go far to eliminate the personal factor. The purchase of other equipment for the testing of soils is being arranged.

In connection with the fluxing and cutting-back of asphaltic products it has been found that with a particular base material the percentage of flux oil or cutting distillate is inversely proportional to the logarithm of the viscosity of the mixture. In other words, the plot of the percentage of flux or light distillate against the logarithm of the viscosity is a straight line. A knowledge of this relationship allows of a proportioning forecast of considerable precision. Given two points on a semi-logarithmic graph the amount of a particular light distillate to be added to an asphalt or a road oil to produce a certain desired viscosity is readily determined. It is also probable that supplementary graphic methods could be applied to the manipulation of two fluxes simultaneously, but so far this has not been attempted.

The Board's technical staff and the Dominion Analyst have been closely co-operating in an effort to develop tests which will be an indication of the durability of asphaltic binders. This problem is exercising the minds of roading authorities throughout the world. As far as the usual thin bituminous carpets laid in New Zealand are concerned it would appear that soft binders which possess low susceptibility to temperature change, and which retain their ductility, are to be desired. Based upon a certain amount of preliminary investigation and results, a series of tests will shortly be undertaken, which, it is hoped, will be an indication of weathering and loss of ductility in service.

With the new and improved methods of extracting oils and light distillates from the crude product of the oil-well, with possible injury to the residual constituents which are depended on for roading purposes, and considering the new and various sources from which our asphaltic binders are supplied to-day, the urgent need for durability tests will be appreciated. The stage has been reached where the service of thin bituminous carpets depends upon the "life" of the binder, and not upon the mineral aggregate, hence the importance of ensuring that only the best asphaltic materials are being used.

HIGHWAY ENGINEERING AND DESIGN.

The past year has been a period of considerable progress in design and construction methods, and of accelerated activity in a programme of widespread improvement to the highways of New Zealand. Every effort has been made to provide an adequate system of road communication with all practicable facilities for the free, orderly, and safe flow of traffic.

The Board is faced with the building of new highways to meet the demand of present-day and future traffic, and with the adaptation of existing roads to meet modern conditions. This means that highway engineering standards must often be based upon compromise between many factors, but a thorough knowledge of certain principles and highway requirements is essential before a reasonable adjustment between the large number of factors involved can be reached. With this in mind the Board continues to pursue an energetic policy of research and investigation into the many problems which remain to be solved.