

Polished Stone Value

Test Procedures and Equipment

Introduction

In 1950 increased traffic flows and higher speeds on trunk roads, together with concerns about road safety, led to research into the relationship between road materials and skid-resistance.

Research at the UK Road Research Laboratory showed a significant relationship between polishing of aggregates used in road surfaces and skid resistance. Tests were devised using an Accelerated Polishing Machine and a friction measuring device, Portable Skid Resistance Tester, to determine a Polished Stone Value.

These developments have resulted in a simple and inexpensive procedure to determine in advance of a road being built what its resistance to skidding will be.

The Accelerated Polishing Machine was first produced 25 years ago. Today, more than 1000 of these machines have been supplied world wide to Materials Laboratories, Consulting Engineers and Research Institutions.

Calculation of Polished Stone Value

The Polished Stone Value of aggregate gives a measure of resistance to the polishing action of vehicle tyres under conditions similar to those occurring on the surface of a road.

The action of road vehicle tyres on road surfaces results in polishing of the top, exposed aggregate surface, and its state of polish is one of the main factors affecting the resistance to skidding.

Resistance to this polishing action is determined principally by the inherent qualities of the aggregate itself. A later section of this memorandum gives some information about the polishing resistant qualities of different sources of aggregate.

The actual relationship between PSV and skidding resistance will vary with traffic conditions, type of surfacing and other factors. All factors together with reproducibility of the test should be taken into account when drawing up specifications for road works, which, include test limits for PSV.

The PSV test is carried out in two stages - accelerated polishing of test specimens followed by measurement of their state of polish by a friction test.

Description of the PSV Test

Full details are given in BS812Part1 14:1989. A copy of this document is essential to understand and carry out the test.

Four curved test specimens are prepared from each sample undergoing test. Each consists of 35 to 50 representative chippings of carefully controlled size supported in a rigid matrix.

Fourteen specimens are clamped around the periphery of the 'road wheel' and subjected to two phases of polishing by wheels with rubber tyres. The first phase is of abrasion by corn emery for three hours, followed by three hours of polishing with emery flour. Two of the fourteen samples are of Control stone.

The degree of polish of the specimens is then measured by means of the Portable Skid Resistance Tester (using a special narrow slider, shorter test length and supplementary scale) under carefully controlled conditions. Control specimens are used to condition and check the slider before the test. Also a pair of control specimens is included in each test run of fourteen specimens to check the entire procedure and to allow for adjustment of the result to compensate for minor variations in the polishing and or friction testing. Results are expressed as 'Polished Stone Values' (PSVs), the mean of the four test specimens of each aggregate.

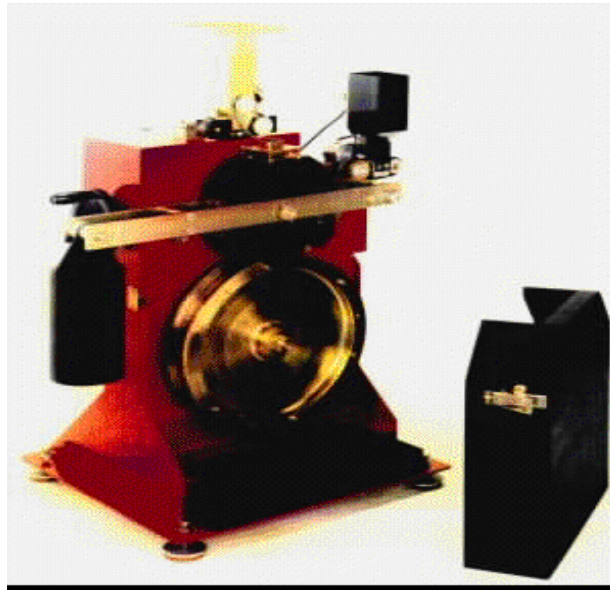
International Use of the PSV Test - BS 812

This British Standard has been adopted and used widely throughout the world. It is the only test with available equipment to calculate PSV's. The Permanent International Association of Road Congresses PIARC in conjunction with RILEM and the American Society for Testing Materials (ASTM), recommend the use of BS 812 to determine Polish Stone Values.

Use of PSV in Road Construction Contracts

In the UK the Highways Agency specify PSV tests in circumstances where resistance to polishing have been found to be important.

Accelerated Polishing Machine



The machine consists of a road wheel, rotating at 320 rpm, to the periphery of which are clamped 14 specimen holders. A solid rubber tyred wheel is positioned vertically above the road wheel, and loaded to exert a force of 725 N.

There are two feed mechanisms and a water supply. The first mechanism feeds corn emery, mixed with water to the junction of the rubber and road wheel, while the second mechanism feeds emery flour, with water, to the same location.

Road Safety and PSV

The fundamental purpose of the PSV is to enable safer roads to be built. In the UK use of PSVs in road construction has had a major influence in reduction of accidents. The following is an interesting example.

Elevated section of M4 experiment

This site, the elevated part of Motorway M4, was found to have a high proportion of skidding accidents when wet. Examination of the records showed that the SFC (Sideways Force Coefficient) of the surface was from 0.35 to 0.45 at 50 km/hr. The road was resurfaced with the highest PSV material available at the time. It had been intended to use calcined bauxite (RASC Grade) for the entire site, but as insufficient material was available, it was decided to mix it with a gritstone from Gilfach quarry near Neath, in South Wales, with a PSV of 71.

During the first three years after resurfacing the SFC was found to have increased to between 0.50 and 0.60 and accidents were substantially reduced.

Petrology and Polishing

Extensive research has shown it is not possible to predict polishing qualities of natural roadstone from petrological data. However some indicators have emerged:

Rocks composed of minerals of widely different hardness, and rocks that wear by the pulling out of mineral grains from a relatively soft matrix, had relatively high resistance to polishing. Conversely rocks consisting of minerals having nearly the same hardness wore uniformly and tended to have a low resistance to polishing.

The gritstone group is excellent, with resistance to polishing being always high, whereas the lime stone and flint groups yield the lowest resistance. Other groups, basalt, granite and quartzite, yield intermediate results.

Resistance to polishing of samples from the basalt group show a wide range. Resistance is higher when minerals of different hardness are present, and when the ground-mass is foliated or fluxioned. The resistance is also influenced by the proportion and hardness of secondary minerals, softer minerals giving higher resistance.

In groups of igneous rocks the petrological characteristics which most readily affect resistance to polishing are variation in hardness between the minerals and the proportion of soft minerals. Rocks with cracks and fractured minerals are of higher resistance, whereas finer- grained allotriomorphic rocks tend to polish more readily.

Types of Polishing and Control Material

Four types of material are used in equipment for calculating PSVs.

Emery Corn

The first three hours of the polishing operation uses this material to remove high spots, and condition the surface of the specimen.

Emery Flour

The second three hours of the polishing operation uses this material to polish the samples.

Control Stone

This stone is used in the polishing Machine to provide a comparison against which the results of the aggregate under test can be measured. 2 out of 14 samples in each test are from this material.

Criggion Stone

Used with the Portable Skid Resistance Tester for calibration purposes.

Portable Skid Tester



The machine is based on the Izod principle. It has a pendulum consisting of a tubular arm rotating about a spindle attached to a vertical pillar. At the end of the tubular arm is a head of constant mass with a spring loaded rubber slider. The pendulum is released from a horizontal position so that it strikes the sample of aggregate with a constant velocity. The friction of the surface of the sample, which has undergone preparation by the Accelerated Polishing Machine, determines the distance the head travels after striking the sample.

The results shown by the Portable Skid Resistance Tester, as Polished-Stone Values are the coefficient of friction multiplied by 100.

The Portable Skid Resistance Tester is calibrated by the use of Criggion Stone, a material of exceptionally consistent characteristics, which comes from a quarry in North Wales.

Other Uses of the Skid Tester

Apart from its key role in calculating Polished Stone Values in a laboratory environment, the Portable Skid Resistance Tester is a principal instrument for testing existing roads, and is an inexpensive alternative to special purpose vehicles. In many countries the use of a Skid Tester usually precedes the purchase and use of an Accelerated Polishing Machine.