Prediction of Pavement Surface Skid Resistance and the Effect of Smaller Chip Size

Birendra Kumar

Dr Douglas Wilson

THE UNIVERSITY OF AUCKLAND
FACULTY OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

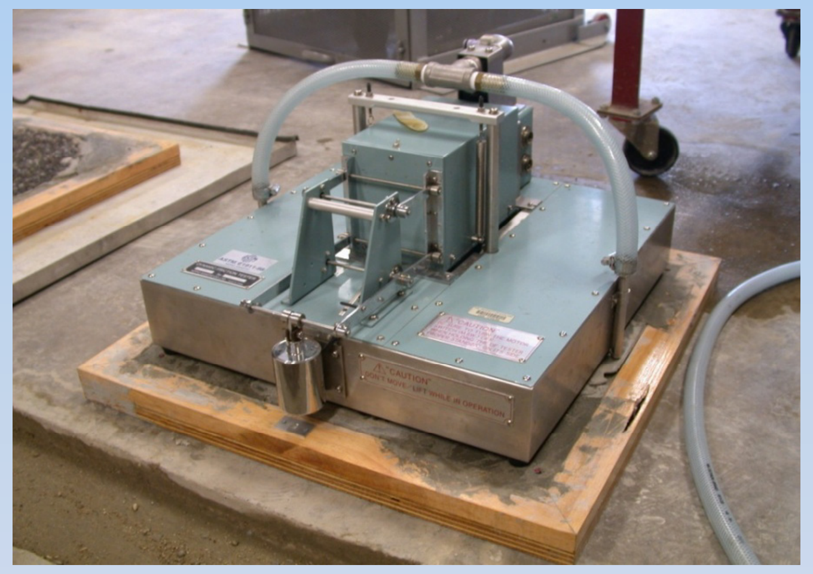
Introduction

Research has demonstrated that the road based transport crash rate increases as the skid resistance of road surface decreases. This research compares the equilibrium skid resistance level of various natural and artificial surfacing aggregates including varying the aggregate chip size under laboratory based accelerated polishing and in response to changes in environmental conditions. Previous research has shown that wet skid resistance of chipseal surfaces is not only a function of the polishing resistance of the aggregate, but also of its size, shape and spacing.

Experimental Methodology

A laboratory experiment was designed at the University of Auckland (UoA) to simulate the in-field skid resistance performance of surfacing aggregates. The experiment required accelerated laboratory polishing, friction testing with a Dynamic Friction Tester (DFT) and surfacing samples to be constructed that were compatible with each other. The testing process and methodological steps are shown in Figure 1.

Step 1: Preparing an aggregate sample to test



Step 3: Friction Testing a prepared Sample DFT (μ)

Step 2: Polishing with Accelerated Polishing Machine

The Dynamic Friction Tester and Rubber sliders

Figure 1: Testing Methodology

Results

The DFT (μ) friction results from a newly prepared surface sample (initial skid resistance) through accelerated polishing in hours for three geologically different aggregate samples (greywacke, basalt and an artificial electric arc furnace) are shown in Figure 2. Two of the materials (greywacke and basalt) were then tested with two different chip sizes (Grade 4 vs. Grade 6). The value at which the DFT (μ) levelled off for each aggregate sample is shown graphically and described as the polished Equilibrium Skid Resistance (ESR) level.

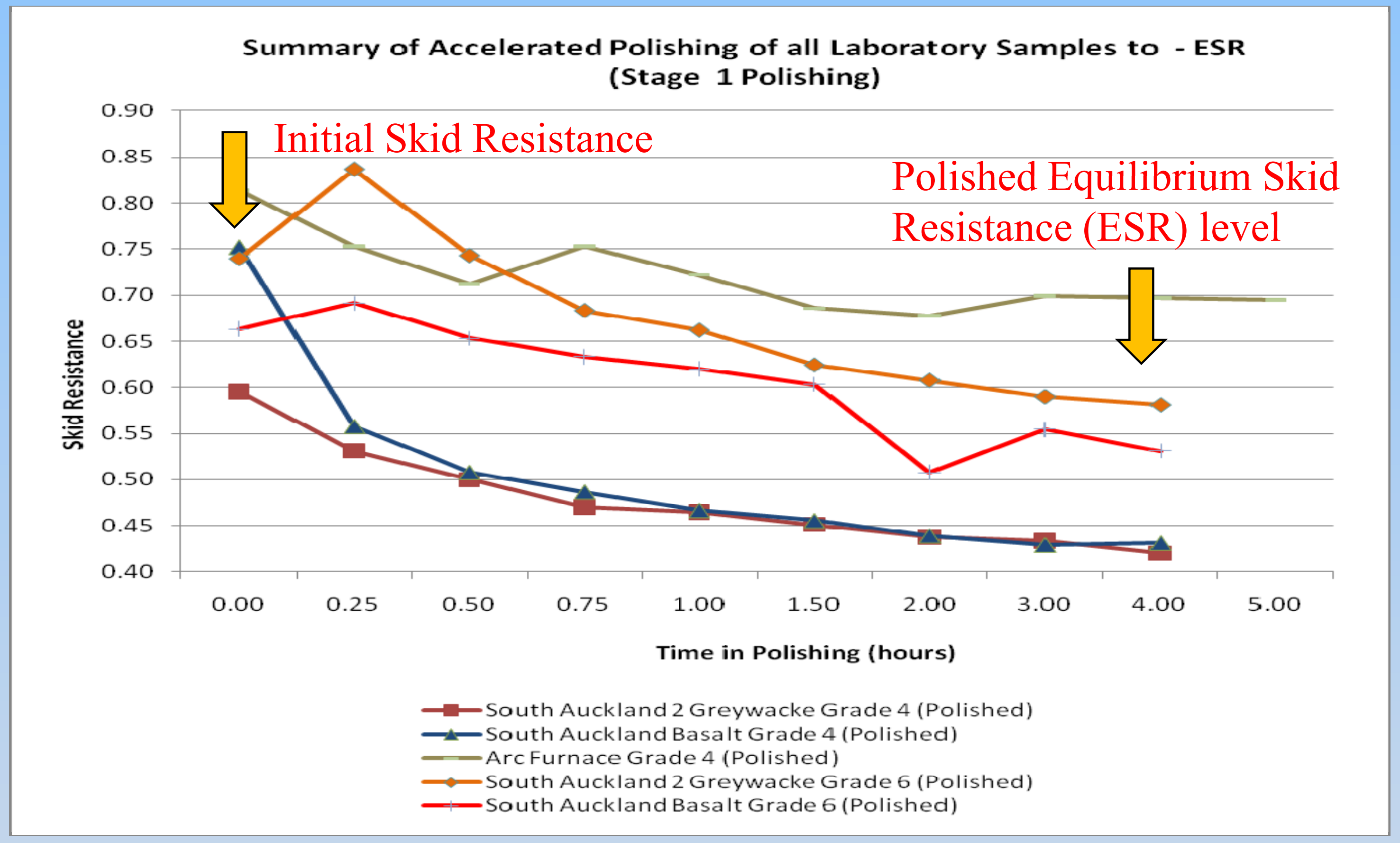


Figure 2: Friction (μ) vs Polishing Time

Figures 3 and 4 respectively for a South Auckland greywacke and a South Auckland Basalt demonstrate the skid resistance improvement of reducing the aggregate chip size from a Grade 4 to Grade 6. The figures also demonstrate the effect on measured skid resistance with the addition of various contaminants after ESR has been reached (oedometer clay, leighton buzzard sand , emery powder) with accelerated polishing after ESR has been reached.

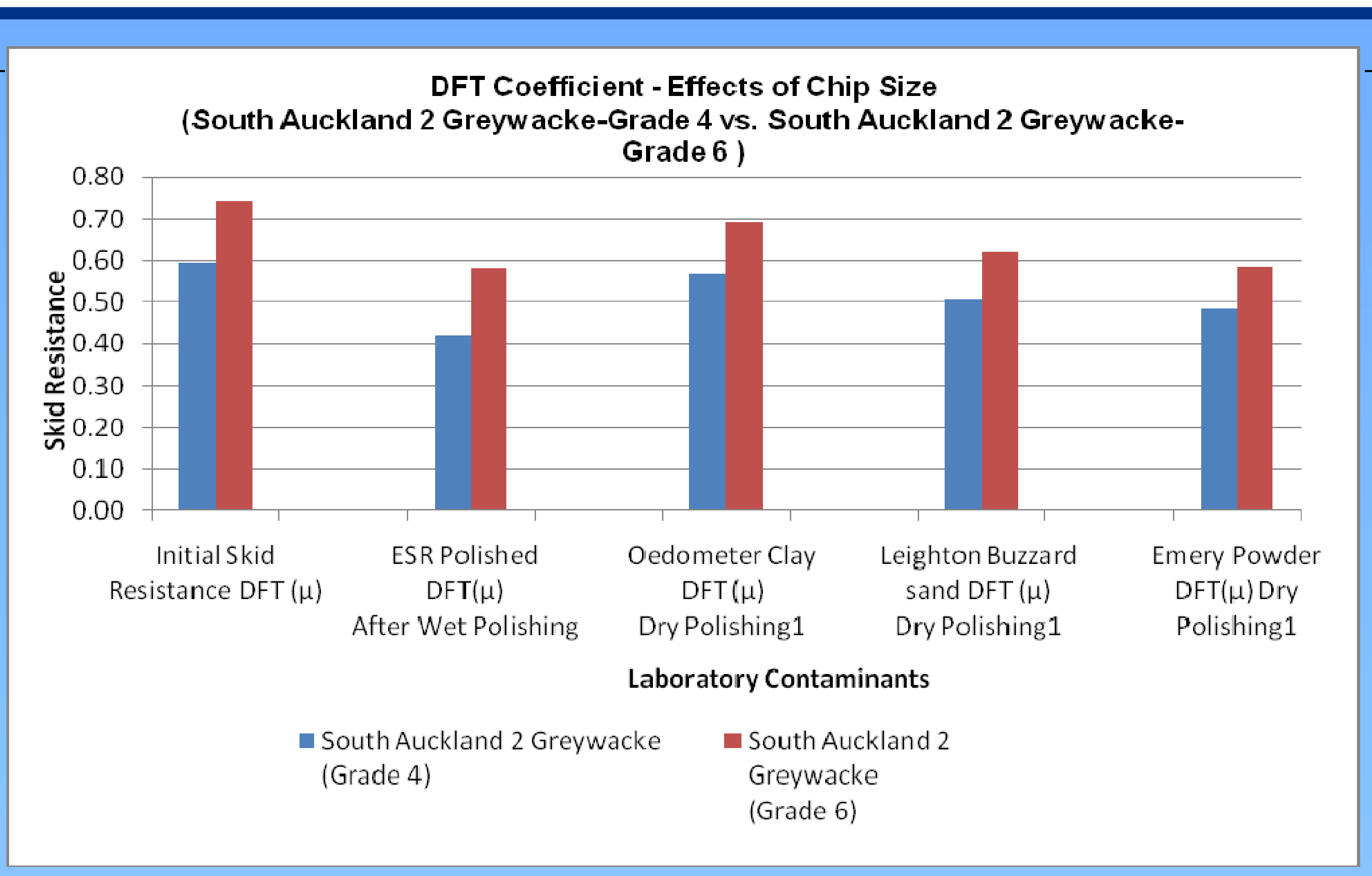


Figure 3: Chip Size effects for Greywacke aggregate

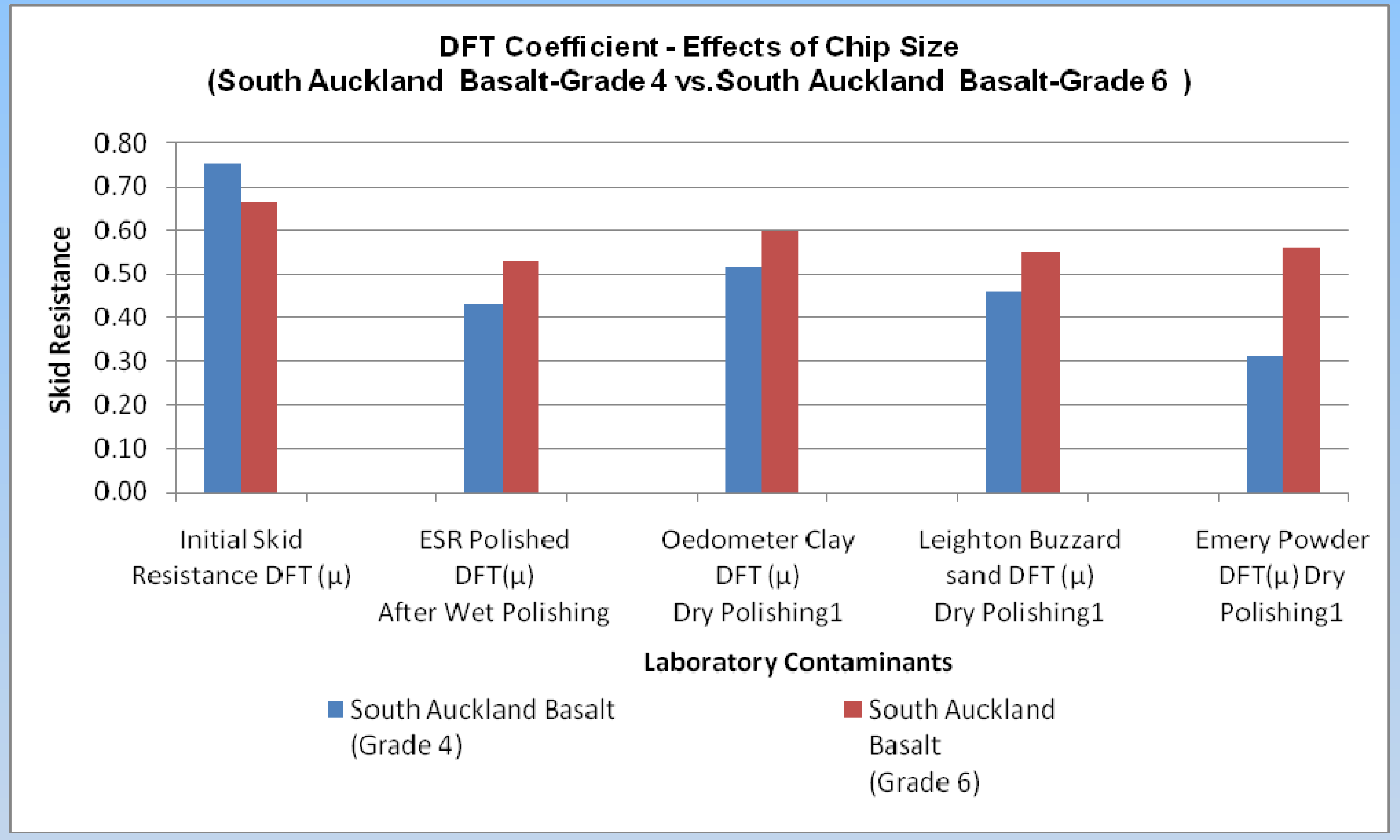


Figure 4: Chip Size effects for Basalt aggregate

Research Conclusions

1) The artificial Electric Arc Furnace aggregate (Grade 4) performed the best of the three geological materials and contaminants had very little effect
2) The Grade 4 greywacke and basalt aggregates performed very similarly at ESR level although the basalt had a much higher initial skid resistance
3) Both the greywacke and basalt aggregate demonstrated a significant improvement when a smaller Grade 6 aggregate chip was used in comparison to a Grade 6 chip (24% and 35% improvement respectively).