



Based on this analysis and an analysis of the effect of gradients on fuel consumption, a linear pavement performance model was developed. Using this model the study concluded that driving on a concrete pavement reduces heavy truck fuel consumption by up to 11%.

Another method of examining fuel consumption is the Spec Manager 2.1 programme by Detroit Diesel ⁽³⁾, which considers pavement structure when determining vehicle fuel efficiency. This programme indicates savings in fuel of 8-17% when running on concrete.

Introduction

There is an increasing amount of research being reported which indicates that fuel consumption is directly related to pavement rigidity. In other words, the stiffer the pavement, the less rolling resistance and in turn the better the fuel consumption. These studies refer to heavy vehicles, which cause greater deflection on flexible pavements than on rigid ones. This increased deflection of the pavement absorbs part of the energy that would otherwise be available to propel the vehicle.

Background

The hypothesis that more energy and therefore more fuel is required to drive on flexible pavements was powerfully made by Zaniewski ⁽¹⁾ as part of a large study by the Federal Highway Administration (FHWA) to update vehicle operating cost tables of an earlier study by the World Bank and Brazilian Government. This comprehensive study of the relationships between highway design and vehicle operating costs looked at several cost components, including fuel consumption. Based on this analysis it was found that savings in fuel consumption for heavy vehicles travelling on concrete compared to asphalt pavements was up to 20%.

For ten years, research in this area appears to have been dormant until the Cement Association of Canada initiated a one year study with the National Research Council of Canada (NRC) ⁽²⁾ to examine the difference in fuel consumption of heavy trucks travelling on flexible and rigid pavements over Canada's four distinct seasons. The resulting analysis revealed a strong correlation between truck fuel consumption and pavement temperature.

A technical information bulletin from the Direction du laboratoire des chaussées of the Quebec Ministry of Transportation (vol. 3, no. 1, January 1998) ⁽⁴⁾ reports rolling resistance factors for concrete of 0.01, and of 0.012 for asphalt pavements, a difference of 20%. This again provides more evidence that concrete pavement provide a surface which can provide heavy truck fuel savings.

Along with the reduction in fuel consumption, there is a corresponding reduction in greenhouse gas emissions. A study by Environment Canada states that 2,730 grammes of CO₂ are created by every litre of diesel fuel consumed.

There is clearly a huge potential for dramatic reductions in greenhouse gas production, which must be attractive to any administration seeking to meet its Kyoto commitments.

In the UK, the Highways Agency has commissioned TRL to carry out some rolling resistance test on different road surfaces. The first test results, comparing exposed aggregate 'whisper' concrete with adjacent Hot Rolled Asphalt on a concrete base tended to confirm the latest Canadian evaluation.

As a consequence, further HA funds have been allocated to researching this topic. In the UK there is a need to discover what effect a thin asphalt surface on a concrete structure has on rolling resistance. If it is detrimental to fuel saving then there will be a powerful case for the reinstatement of exposed aggregate concrete as an approved surface.

If the evidence of fuel savings is positive in favour of concrete, and a saving of just 5% would be massive, there is the prospect of all truck lanes on major routes being constructed in concrete. It is a win, win situation with long life, low maintenance, rut-free, low rolling resistance and low emission highways being virtually self-financing.

References

- (1) (Zaniewski 89) Zaniewski, J.P., "Effect of Pavement Surface Type on Fuel Consumption", SR289.01P, Portland Cement Association, Skokie, Illinois, 1989.
- (2) (NRC 00) National Research Council of Canada, "Effect of Pavement Surface on Fuel Consumption – Phase 2, Seasonal Tests", National Research Council of Canada, Centre for Surface Transportation Technology, Ottawa, Ontario, April 2000.
- (3) (Detroit Diesel 00) Detroit Diesel, Spec Manager Computer Program Version. 2.1.3, 1999.
- (4) (MTQ 98) Technical Information Bulletin, Direction du laboratoire des chaussées of the Quebec Ministry of Transportation, vol. 3, no. 1, January 1998.

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