Scott Wilson Pavement Engineering

Asphalt could be an effective and environmentally friendly means of making use of an industrial waste.

Research reveals new resource for asphalt

Landfill has traditionally been the only means of disposing of furnace slag resulting from production of zinc. But forming part of an asphalt matrix is becoming another option, thanks to new research being carried out in part by Scott Wilson Pavement Engineering (SWPE).

Imperial Smelting Furnace (ISF) slag is currently being produced at a rate of around 80,000 tonnes each year from Britannia Zinc Ltd's (BZL's) Bristol plant. ISF slag contains traces of chemicals including cadmium and arsenic as well as zinc. Disposal at landfill is controlled to minimise environmental impact, but there are clear benefits to be had by finding an alternative use for ISF slag.

Recycling the waste would relieve pressure on available landfill space and finding a construction use for the material would contribute to targets for reducing the demand for quarried aggregate. For BZL, there is the benefit of reducing substantial landfill tax payments.

The zinc supplier is one of a long list of companies and organisations interested in finding alternative uses for waste from non-ferrous metal production. These include the Engineering Directorate of the Department for Trade & Industry, aluminium producer Alcan Smelting & Power and BZL's sister company Britannia Refined Metals.

"The binder significantly reduces leaching. The outlook for ISF slag is good."

Richard Elliott.

The overall project is being led by the Building Research Establishment (BRE), which has separated the ISF slag work into two streams. BRE is investigating use of ISF slag in concrete and has commissioned materials consultant Scott Wilson Pavement Engineering to evaluate the slag as a constituent of asphalt mixes.

With 15 partners, SWPE is playing a major part in the overall project titled 'Use of Non ferrous Waste Streams as Bound Aggregates in Construction' of which the ISF slag work is part. The brief includes investigation of construction uses of waste from production of several non-ferrous metals including aluminium. But work on ISF slag from zinc smelting is by far the furthest advanced.

"The majority of our work so far has involved investigating the environmental effects of leaching from ISF slag," says SWPE associate Richard Elliott.

"It is important to remember that small quantities of chemicals such as arsenic and cadmium are present in many waste materials and can be detectable in some water courses. For furnace slag from zinc production to be accepted for use in road construction, we have to demonstrate that leaching of chemicals will not exceed stringent water quality standards."

SCOTT WILSON PAVEMENT ENGINEERING is a joint venture between Nottingham University, the Scott Wilson group, and granular and bituminous materials specialist Professor Stephen Brown.

SWPE was originally established in 1985 to transfer research into practice. It successfully introduced the Falling Weight Deflectometer (FWD) device for measuring pavement stiffness and the Nottingham Asphalt Tester for assessing deformation resistance into the UK. An FWD will be used to assess the performance of asphalt containing ISF slag in the full scale trials.

Results are promising. Tests have shown low potential for heavy metal pollution of groundwater. Testing began with assessment of leaching from unbound samples of the fine ISF slag, which contains particles no larger than 4mm. According to Elliott, results of this worst case scenario test showed levels of some chemicals marginally above those recommended in water quality standards.

"More importantly though, leaching tests on compacted ISF slag samples bound with bitumen produced results well within water quality standards", he says.

Tests were carried out on unbound compacted samples, a pure compacted slag bound with bitumen, and a bitumen bound conventional aggregate with partial replacement of sand sized material by ISF slag. Measurement of total dissolved ions, including arsenic and zinc, showed great reductions for the 'real mixes', reflecting very low potential for heavy metal pollution from ISF slag asphalts. "The binder significantly reduces leaching," says Elliott.

This outcome has proven sufficiently positive to spur the project on to the next phase: full scale trials of asphalt containing ISF slag. Appropriate mixes for field trials are being developed on the basis of a 30% ISF slag content.

Around 30 million tonnes of asphalt is being laid annually in the UK, according to the Institute of Asphalt Technology, so it seems that even a marginal take up of ISF slag could quite easily account for all of BZL's annual output.

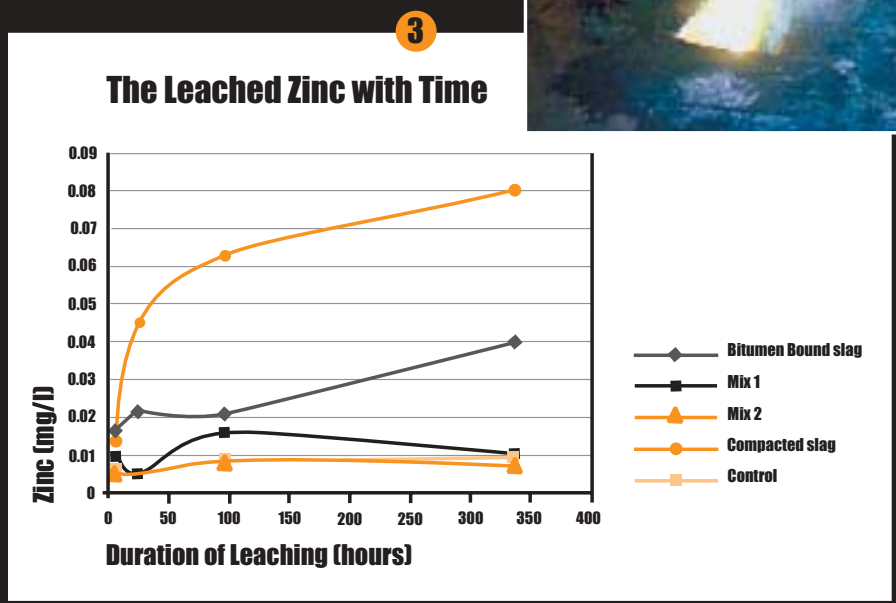
Suitable ISF slag asphalt mixes have to be developed and proven first. Laboratory work on mix designs will precede full scale trials likely to be carried out on a haul road at BZL's Bristol site. Full depth road construction could include a cement bound ISF slag road base beneath ISF asphalt binder and surface courses.

Proof of performance could mean that ISF slag gets accepted in a similar manner to pulverised fuel ash, used now for many years as a cement replacement in concrete. The HA and Environment Agency, whose endorsement may prove critical for overall acceptance of ISF slag, are involved in the project in a consultative capacity.

1: Use of slag from zinc production in asphalt will relieve pressure on landfill space.

2: Zinc smelting produces a fine waste that could provide 30% of aggregate content in the asphalt matrix.

3: Test results have shown low potential for heavy metal pollution from ISF asphalt.



SWPE has grown in both size and reputation, building on the success of the FWD combined with pavement expertise and resources brought by each of the partners. The firm's projects have involved considerable overseas work as well as production of a number of influential design manuals and research studies for the UK Highways Agency.

SWPE also has strong links with the Nottingham Centre for Pavement Engineering (NCPE), one of the UK's leading pavement laboratories. It was at the NCPE facility that SWPE carried out leaching tests on ISF slag.