



Steel Slag Asphalt: Preventing the Waste of a High Quality Resource

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The Presentation

- What is Steel Slag?
- Why use steel slag?
- Importance of control
- Steel slag properties
- Benefits in asphalt
- Steelphalt and its products

What is Steel Slag?

- A by-product of the manufacture of steel
- A high quality resource
- An extremely versatile material
- Registered under Reach Regulations by the European Steel Industry

In the view of the steel producer and the slag processor: IT IS NOT A WASTE!

(Unless discarded to landfill and contaminated)

Basic Oxygen Steel Slag (BOS)



Electric Arc Furnace Steel Slag (EAF)



Why Utilise Slag?

- Historically
 - Either sent to landfill or de-metalled and sent to landfill A WASTE
 - Costly
 - Unsightly
 - Environmentally unacceptable
 - A waste of a high quality resource

Why Utilise Slag?

- Current world- wide situation
 - Landfill becoming scarce or more expensive or both
 - Natural aggregate resources are becoming more difficult to develop
 - Negative environmental impact of Quarrying
 - The world is becoming more environmentally aware – planning for the future
 - Market driven enforcing recycling



Countries Using Steel Slag in Road Construction

	United Kingdom		Luxemburg
	USA	۲	Portugal
*	Australia		Malaysia
	New Zealand	(***	Singapore
>	South Africa		Norway
	Belgium	•	Japan
	Brazil		Romania
*	Canada		Czech Republic
-	Mexico	63	Guatemala
SERVICE	Saudi Arabia		Greece
	Poland		Denmark
	France		Holland
	Germany		Italy

Slag Handling/Processing



Controlling Expansion

- Free lime CaO MgO
- No direct relationship to content
- Depends on minerals formed
- Relates to chemical composition and cooling rate
- Preferable to test the actual property



Controlling Expansion

- European Standard Test Method
- Harsco Designed Proprietary
 Test Equipment
- Graded sample of steel slag
- Compacted into a mould
- Steam passed through sample for 168 hours
- Volume increase measured
- Main factory production control for steel slag



Typical Expansion Curves

BOS Slag

EAF Slag



EN 13043:2002 Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas

Type of steel slag	Expansion Percent by volume	Category V
BOF slag/EAF slag	< 3.5 <6.5 <10 >10	$V_{3.5}$ $V_{6.5}$ V_{10} $V_{Declared}$
	No Requirement	V _{NR}

Consequence of Failure

- Remedial cost liability
- Reputation of material
- Prohibition of future supplies of slag based material
- Potential Moratorium Ontario
- Closed gates on the slag industry



Beneficial Properties in Asphalt

- Environmentally sustainable
- Resistance to deformation
- Skid resistance
- Resistance to abrasion
- Affinity to asphalt binders



Environment & Sustainability

100%		100%	
80%		80%	
60%		60%	
40%		40%	
20%		20%	
0%		0%	
	Natural Aggregate		Steel Slag
	RecycAlgegdrega	eQuarAiged	egate Bit

umen

Deformation in the UK!!!



Shape



Wheeltracker

- Resistance to deformation – rutting
- Simulative test
- Test at 45°C or 60°C



Steel Slag Asphalt Provides the Solution



Wheeltracking rate in mm/hr at 60°C



Skid Resistance



Grip Tester



Grip values for steel slag surfacing





18 Years Old

Ulster University Study

- Why do steel slag asphalts maintain their skid resistance?
- Full comparative test program
- Development of extended polishing and water conditioning regimes to simulate natural weather conditions

Regeneration of Frictional Properties

Abrasion Resistance



Binder Affinity

Granite

Steel Slag



Asphalt Binder Retention



Steelphalt

- Coating steel slag since in 1934
- Steelphalt formed 1964
- Coated over 15 million tonnes of both carbon and stainless steel slag into high quality asphalt surfacing materials
- Manufacture EAF, BOS and stainless steel slag asphalt



SteelSurf

- Industries applications
- 300 tonnes
- 3 axles
- Channelized travel
- >15 years old





- Local authority roads
- Low speed
- High stress locations

SteelPave

- Thin surfacing
- Stone Mastic Asphalt
- High texture
 - Reduce spray
 - Reduce noise
- Low voids durability
- Rut resistant
- First Laid in 1995 still performing well today



UtraGrip

- Developed from Steelpave
- Polymer modified binder
- Polymer modified bond coat
- 10mm nominal size
- Laid 20mm thick
- Used mainly on local roads



SteelFlow



more durable more water-tight more flexible

less material

Tel: 01709 300500 email: steelphalt.uk@harsco.com

SteelPhalt - Stay safer

only needs to be laid 15mm thick

SteelFlow





Conclusions

- If handled, processed and marketed correctly, steel slag can be a high quality resource
- Steel slag provides asphalt with superior performance to many natural aggregate equivalents
- It's use is environmentally beneficial as it:
 - Reduces landfill
 - Reduces the need to quarry
 - · Extends the life of road surfaces

Thank you for your Attention Any Questions