

**GSV**



ArcelorMittal

**Steelmaking slags,  
state of the art  
Belgium**

Belgium Steel Federation

ADER



## Status for Belgium



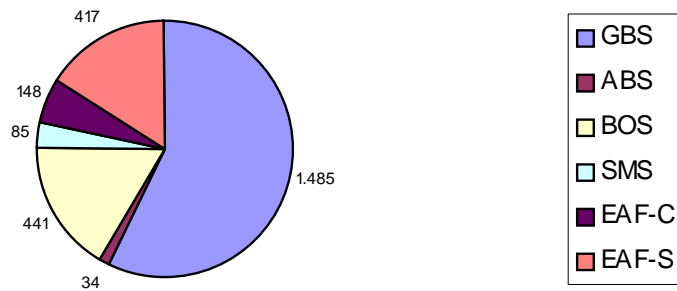
- Production figures and sales 2010 and 2011
- Waste frame directive
- Future developments to create added value with steel slags:
  - LD Gravel
  - Carbstone



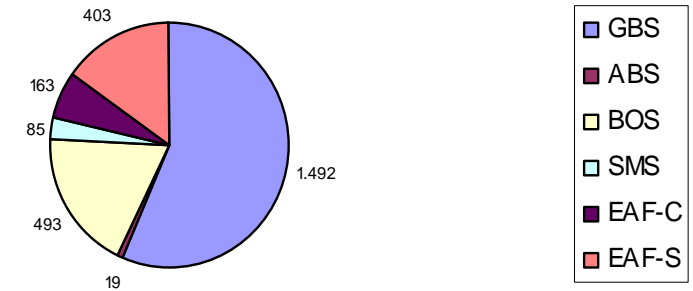
# Slag Production and sales



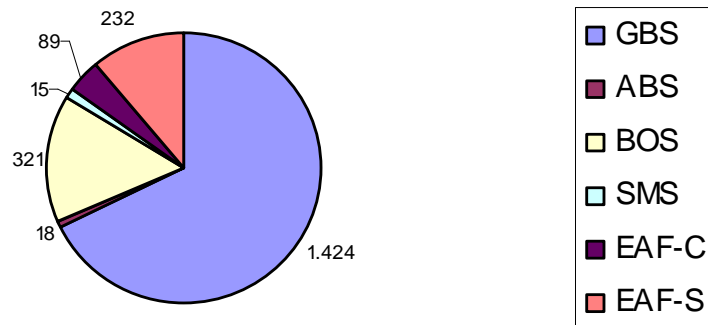
Slag Production 2010 Belgium 2,61 milj. T



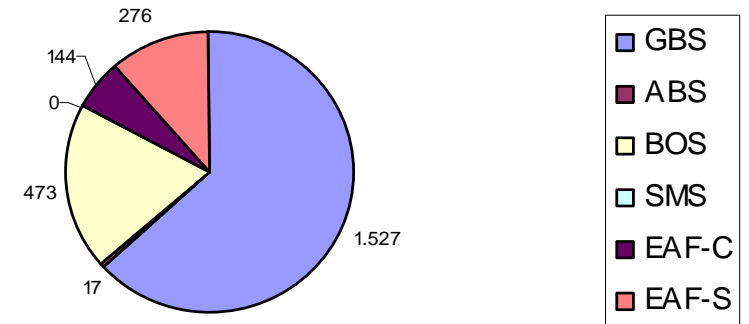
Slag Production 2011 Belgium 2,67 milj. T



Slag sales 2010 Belgium 2,10 milj. T



Slag sales 2011 Belgium 2,44 milj. T





# Market for Slags in Belgium



- EAF slags into concrete and road construction
- Granulated Blast Furnace Slags
  - Sales to cement plants
  - Sales to concrete plants (after grinding to GGBFS)
  - Sales to Grinding plants to Glass industry
- Air cooled Blast Furnace Slags
  - Sales for Stone wool
  - Sales to road construction
- Steel slags
  - Internal use in steel and hot metal process
  - Fertiliser
  - Water reinforcement
  - Stabilisator
  - Slag maker in non-ferro/ concrete
  - Road construction (unbound)



## Status for Belgium

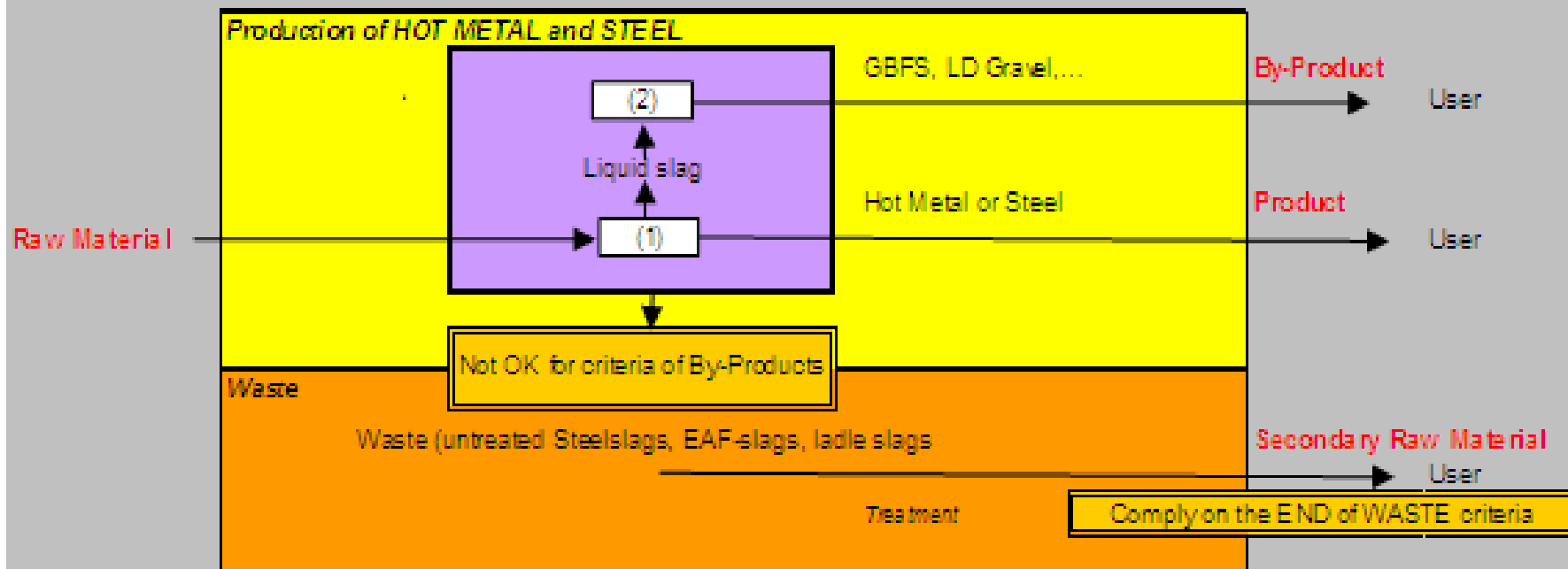


- Production figures and sales 2010 and 2011
- Waste frame directive
- Future developments to create added value with steel slags:
  - LD Gravel
  - Carbstone

- Is not yet convert into Belgium law; for the time being:
  - Wallonia: all slags are registered as waste
  - Flanders: BF slags and LD-Gravel are “de facto” products
- Since last year the GSV (the Belgium Steel Association) is working on a common directive for Belgium.
- First, it’s the producer who decide what will be the status of the slag
- Second, this status is linked on the final application of the slag; which is linked on the treatment of the liquid slags.(see flow)
  - First: “by-product-check” (WFD art.5)
  - Second: “EoW-check” (WFD art.6) when slag don’t fulfil art.5

- (1) installation for the production of Hot Metal and Steel
- (2) Treatment plant for liquid slags

Liquid phase





## Status for Belgium



- In Flanders the local government is working on a “Materialendecreet” and “VLAMAB uitvoeringsbesluiten”.
  - By-Products slags will be put into the market without “grondstoffen verklaring” (a declaration of basic raw material).
  - But “EoW-slags will need a “grondstoffen verklaring” (a declaration of basic raw material).
- In Wallonia the work is ongoing of the WFD tot the “Plan Wallon Déchet 2020”, where GBFS will get the statue of “By-Product” and all other slags à priori the waste status.
  - So Discussion still on going in Belgium...





## Status for Belgium



- Production figures and sales 2010 and 2011
- Waste frame directive
- Future developments to create added value with steel slags:
  - Stabilisation of BOS-slags → LD-gravel
  - Carbonation of BOS-slags → Carbstone

– New developments with BOS-slags LD-gravel



PROBLEM: CaO → not volume stable  
 → bound the CaO by SiO<sub>2</sub>  
 → Generate oxydation heat by adding O<sub>2</sub>

**At the stabilisation plant:**  
**LD-slag + SiO<sub>2</sub> (sand) + O<sub>2</sub> → LD-gravel**

Final product: stabilised BOS-slag or LD-gravel → < 1% volume extension (swelling test)

<b>LD-slak</b>	→	<b>LD-grind</b>
CaO, 3CaO.SiO <sub>2</sub>	→	CaO.SiO <sub>2</sub> , CaO.FeOn
B = 4,5	→	B = 1,8
CaO free = 15%	→	CaO free < 1%
Δ vol > 10%	→	Δ vol < 1 %



## New market for LD-gravel in Belgium



- Reduction of the use of granulates (stones) from quarries
- Potential market for LD-gravel are concrete blocks where high density is demand, like “lego®” blocks.



# GSV New Market for LD-gravel in Belgium



- Tests for asphalt applications ongoing



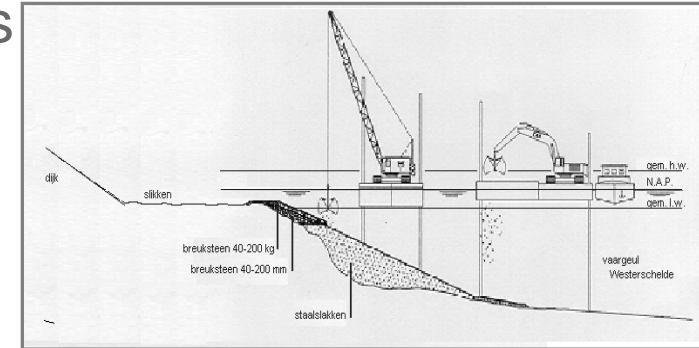


## New Market for LD-gravel in Belgium



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Due to higher specific gravity (+10% on natural stones) target is making blocks for reinforcements of dykes  
LD-gravel as replacement for Scottish or Norwegian granite in reinforcement of waterways and also big blocks in dykes.





# Carbstone

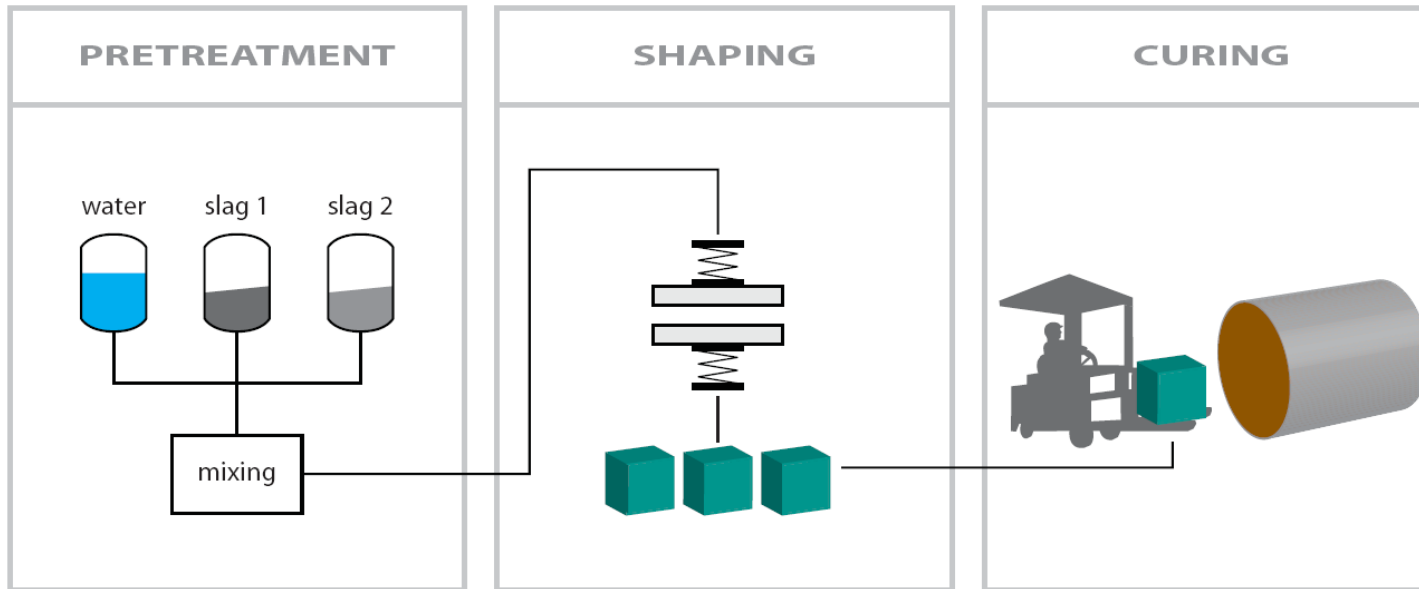
An innovative technology for  
Valorisation of BOS-slags and CO<sub>2</sub>



CO<sub>2</sub>



- Production process for high quality building/construction material;
- Main raw materials are fine grained slags and CO<sub>2</sub>;
- No traditional binders (eg. cement) are used;
- Carbonates that are formed in-situ glue particles together and provide strength;



- Process consists of 3 steps: pretreatment of materials, shaping and compaction and curing in contact with CO<sub>2</sub>;
- Lime, portlandite and Ca/Mg-silicates react with CO<sub>2</sub> to carbonates:
  - $\text{CaO} + \text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2$
  - $\text{Ca(OH)}_2 + \text{CO}_2 \longrightarrow \text{CaCO}_3 + \text{H}_2\text{O}$
  - $\text{CaSiO}_3 + \text{CO}_2 \longrightarrow \text{CaCO}_3 + \text{SiO}_2$





- Process developed for **steel slags (BOS, EAF)** but also works for other slags rich in Ca and Mg (oxides, hydroxides and/or silicates);
- CO<sub>2</sub>-balance is around -460 kg CO<sub>2</sub>/m<sup>3</sup> Carbstone block;
- Range of construction products are feasible: dike reinforcement, traditional concrete blocks, etc...