

The non-ferro industry in Belgium

A. Poffijn



EAN-NORM Dresden

Overview

General information

The zinc/copper industry

The molybdenum industry

➤ **Current situation**

➤ **Historical relics**

Conclusions

General information (I)

Basic non-ferrous metal production

Production	World (kton)	Belgium (ton)
Al	31895	500
Cu	16425	139000
Pb	7573	96000
Zn	9282	285000

General information (II)

Major production sites in Belgium

Company	Production sites	Products
Affilips	Tienen	Al, Cu, Pb
Campine	Beerse	Sb, Pb
Corus	Duffel	Al
De Craene/Cramet	Kruishoutem	Zn
Hydrometal	Engis	Zn, Cu ,
Lamifill (Lamitref)	Hemiksem	Al,Cu
Métallo-Chimique	Beerse	Cu , Sn
Montefiore	Huizingen	Cu, Ni
Nyrstar	Balen,Overpelt	Zn , Pb, Cd
Remi Claeys	Lichtervelde	Al
Rezinal	Zolder	Zn
Sadaci	Gent	Mo
Stillemans	Zellik	Pb
Stoop	Vilvoorde	Pb,Sn
Umicore	Hoboken, Olen, Angleur, Heusden-Zolder	Co, Cu, Pb,Ge,Zn
Zinacor	Angleur	Zn

Zn/Cu production (I)

Zinc refinery

- **Balen-Overpelt zinc unit**
- **Hydrometallurgic process :**
 - **Roasting**
 - **Leaching**
 - **Purification**
 - **Electrolysis**
 - **Smelting**

Zn/Cu production (II)

Wastes/residues from zinc refinery

Process Source	Waste/Residue	Amount Generated	Potential End Use
		(kg/t Zinc)	
Roaster/sulphuric acid	Sulphuric acid	1,75	By-product for sale
	Mercury-product	0.3-0.8	Sale
	Acid sludge	<0.5	Recycle to Roast or controlled disposal
Leaching	Natural leach residue	500-600	To hot acidic leach, ISF or Waelz Kiln
	Goethite	350-650	Controlled disposal
	Lead-Silver (PbAg) concentrate	40-120	Silver recovery
	Final residue (Pb/Ag removed)	150	Controlled disposal
Purification	Cadmium	2-4	By-product for sale
	Cu / Co- cementates	up to 10	Sale
Wastewater treatment	Precipitated sludge	10	Disposal

Zn/Cu production (III)

Overall data B-O zinc refinery IN (2006)

- Total: 487000 ton (low radioactivity)
- Concentrates (80%) & recovered products (20%)

OUT (2006)

- Zinc products: 270000 ton
- BLP (Pb/Ag): 44666 ton → Precious Metal Refinery
- Goethite: 75000 ton (**radioactivity content ??**) → disposal
- Cu and Co-Ni cementates: 2218 ton & 665 ton (**enriched in U-238**) → *sold to metal processing industry*
- Sulphuric acid: 338146 ton → sold to chemical industry

Zn/Cu production (IV)

Cementates zinc refinery

Laboratory analysis

U-238: < 1 Bq/g up to 15 Bq/g

Ra-226: <<

Th-232: <<

K-40: <<

Count-rate in contact transport containers

10 – 20 cps (BG: 5 cps)

Zn/Cu production (V)

Upgrading cementates for metal processing

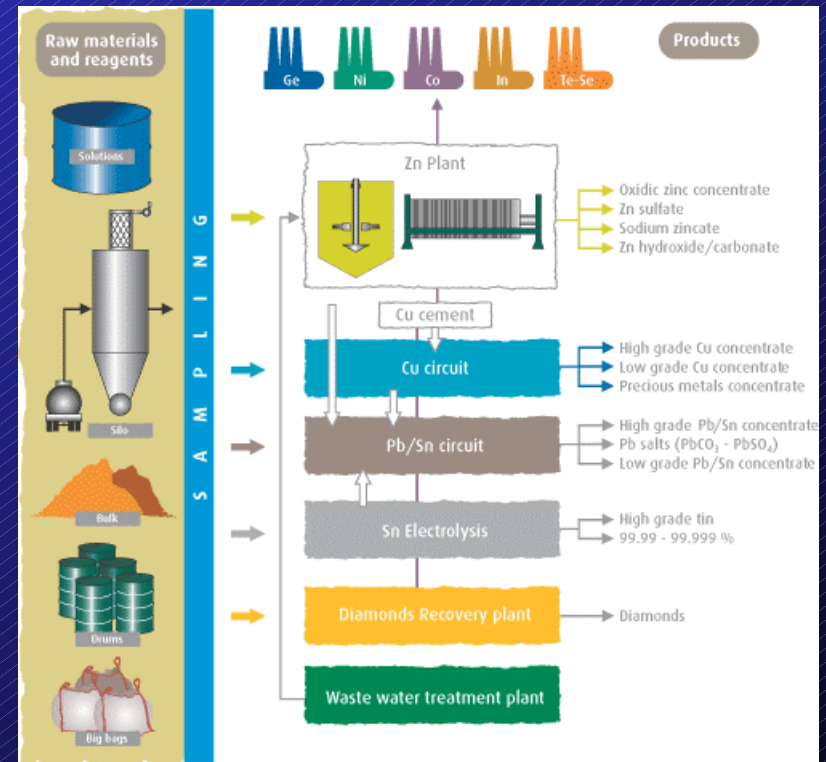
Hydrometal

- Treatment of complex residues from non-ferro industry
- Yearly input: 45000 ton, 1000 ton Cu-Co cementates
- Process: etching by acid or bases & purification
- Output: more simple, purer metal containing salts or concentrates (copper fraction: 300 ton/y)

Zn/Cu production (VI)

Upgrading cementates for metal processing (cont')

- U-238 in copper product fraction:
~2 x Cu-Co cementate
(similar as for Cu)
- Other product fractions:
negligible radioactivity content
(confirmed by dose-rate measurements in contact with material heaps)
- External dose-rates to workers:
normal values (80-120 nSv/h)



Zn/Cu production (VII)

Cu-processing of the upgraded cementates

Metallo-Chimique

- Only secondary input material
- Process: smelter, convertor, (electrolysis) refiner
- Products out of the smelter:
 - intermediate “Black copper” (→ convertor etc...)
 - “end” products: 180000 ton/y Metamix (building industry)
2400 ton/y filter dust (Zn-industry)
- Cu-input (12/2003): 500 ton; upgraded cementate with 50%
22 Bq/g U-238 (Pb-210: 15) and 50% 0.8 Bq/g U-238 (Pb-210:0.4)

Zn/Cu production (VIII)

Cu-processing of the upgraded cementates (cont')

- Most of radioactive isotopes in Metamix
- Po-210 in filter dust
- Traces of Po-210 and Bi-210 in the lead fraction
- Estimated external gamma exposure estimated per workload: $\ll - 110 \mu\text{Sv/y}$



Zn/Cu production (IX)

Radioactivity in Cu-smelter products

Campaign with “22 Bq/g”

“Normal” campaigns

(Bq/g)	Metamix	Filter dust
U-238	0.6	
Th-232	< 0.01	
K-40	< 0.08	
Pb-210	< 0.04	0.1
Po-210	-	9.6

(Bq/g)	Metamix	Black copper
Ra-226	0.03 - 0.1	< 0.01
Th-232	0.3 - 0.8	0.01 - 0.02
K-40	0.1 - 0.4	0.1 - 0.2

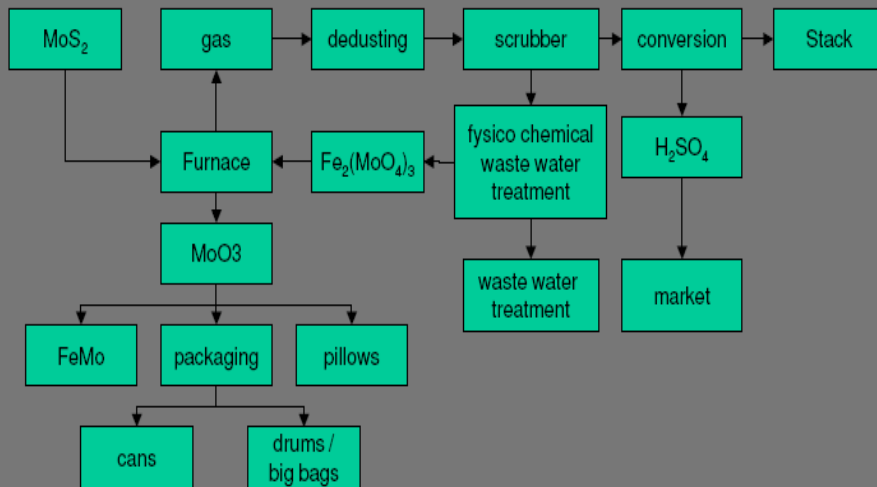
Molybdenum production (I)

Sadaci nowadays

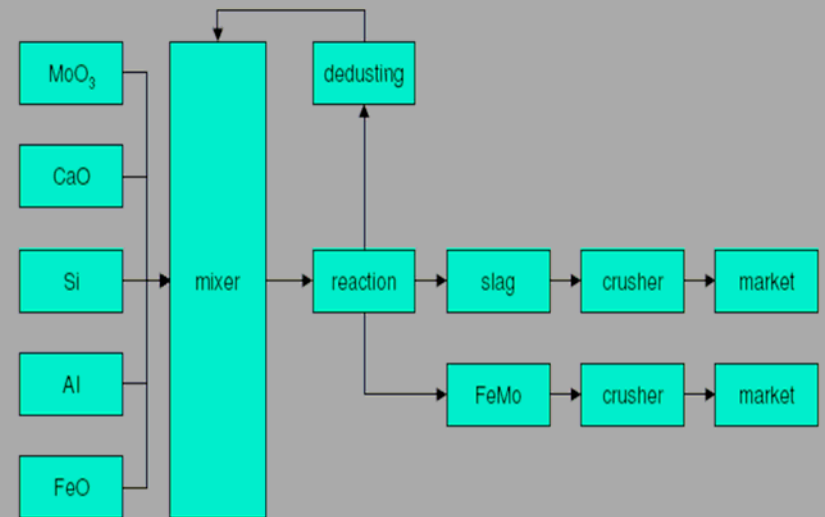
- The only Mo roaster facility in Europe
- Processes: Roasting - Smelting
- Input: MoS_2 (from Mo or Cu mining)
- Products:
 - MoO_3 (10000 ton/y)
 - FeMo (14000 ton/y)
 - Sulphuric acid (35000 ton/y)
- Residues:
 - Slag FeMo production (42000 ton/y)
 - used in concrete
 - Filtercake waste water treatment (300 ton/y)
 - disposal

Molybdenum production (II)

Mo Roasting



Ferromolybdenum (FeMo)



Molybdenum production (III)

Radioactivity content of materials

<i>(Bq/kg)</i>	MoS₂	Slag FeMo	Filter cake
Ra-226	33	58	< MDA (5)
Th-232	11	16	< MDA (5)
K-40	9	75	10

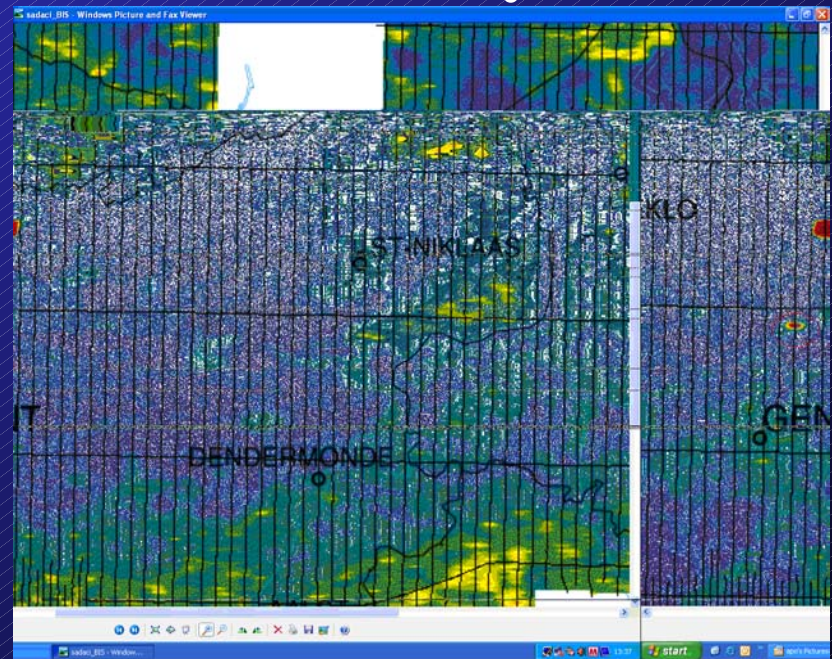
*Error at 2 x sigma level: 8% for Ra-226; 20% for Th-232
15% on 75 Bq/kg and 70% on other K-40 values*

Molybdenum production (IV)

Sadaci in the past

- Ferroniobium production from 1960 till 1985
- Waste material used for raising and levelling terrain of 4 ha (non accessible to the public)
- Nowadays partly covered with asphalt
- Traceable on aerial map

Thorium image aerial survey



Molybdenum production (V)

Investigation of old FeNb dump site

Gamma dose-rate

- The levels at 1m height vary from 0.1 up to over 1 $\mu\text{Sv/h}$
- Hotspots with levels in contact up to 20-30 $\mu\text{Sv/h}$
- In heaps (5000 ton) with material excavated under asphalt covered part: similar “stony” hotspots

Sample analysis

(Bq/kg)	SA1	SA2
Ra-226	4600	5200
Th-232	71000	66000
K-40	5200	5000

*“ Old” analysis of slag material:
high levels & disequilibrium between
Ra-226 and U-238*

Conclusions

Non-ferro is complex industrial sector:

- Many types of processes
- Heterogeneous origin of basic materials
- Increased use of secondary material is common trend (radioactive scrap!)
- (Probably) no RP problem for workers. Attention to maintenance workers (lining refractory material; scalings)
- Minimising disposal: use of residues in building materials (EU regulation!)

Special attention to ferroniobium sector

A landscape photograph showing a field of tall grass in the foreground. In the middle ground, there is a line of trees, some with autumn-colored leaves. To the left, a tall metal utility tower stands. The sky is overcast and grey. The text "Thank you for your attention" is overlaid in yellow in the center of the image.

Thank you for your attention