The importance of understanding material flows: The Nickel perspective

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Agenda

- Nickel & Nickel Institute
- Existing knowledge & data
- Added Value of MFA
- MFA for Nickel
- Using MFA in decision making
- Outlook
Part 1:

Nickel & Nickel Institute
The Nickel Institute

- Members: Nickel and Ni compounds producing companies
- 25 Companies: main producers & growing number of emerging producers
- Comprising ~75% world primary nickel production
Mission Statement:
“To promote and support appropriate applications of nickel”
Nickel mining, Nickel & stainless steel production
Nickel properties

**Properties**

- High melting point, 1453ºC
- Adherent oxide film
- Corrosion and heat resistant alloys
- Strength
- Ductile
- Alloys readily - as solute and solvent
- Magnetic at room temperature
- Deposited by electroplating
- Catalytic
- Electrochemical properties

→ Higher efficiency
→ Better functionality
→ Longer life time
→ Less maintenance
→ Lower material intensity
The Nickel advantage

→ Higher efficiency
→ Better functionality
→ Longer life time
→ Less maintenance
→ Lower material intensity
Part 2:
Relevance & Expectations into MFA

Why to invest into MFA?

- Significant Nickel production increase since discovery
- Knowledge on use, collection, recycling is limited as outside nickel industry
- Data highly important to demonstrate material stewardship

Source: USGS
Unit: gigagram nickel per year (Gg/a, kilotons/year)
Our knowledge of the value chain dimensions

- Data on environmental and human health dimension
- Data on process in- and outputs
- Material flow data for first parts of the value chain
- A lack of understanding when it comes to use phase, recycling and landfilling
- Limited understanding of stock building
Our target

1. how nickel moves through society
2. Knowledge of current & future nickel stock in society
3. Identify where potential for improvement lies
4. Quantify potential & region for improvement
5. Identify relevant stakeholder in the value chain
6. Measures to improve

→ Get complete overview & understanding of value chain
Our expectations

Answer to following questions:

1. Where are losses?
2. How much material in stock?
3. Where?
4. When available?
5. Type of material?
6. Recycling efficiencies?

→ Data are of key importance
Part 3:

Modeling Nickel Material Flows
The following slides were kindly provided by Dr Barbara Reck (Yale University).

The work results from an ongoing cooperation since 2005 between the Nickel Institute and Yale University.

A special thanks to Tom Graedel & Barbara Reck.
Nickel production

- Detailed model of nickel production as basis
- Data from companies and statistics used
- Assumptions in areas where data not available

Nickel stocks and flows model

Fabrication
- Stainless steel
- Alloy steel
- Nickel & nickel-copper alloys
- Plating
- Foundry
- Others (Batteries, catalysts, etc.)

End-use sectors
- Building & Infrastructure
- Transportation
- Industrial Machinery
- Household Appliances & Electronics
- Metal Goods


Ni
Nickel
Global Nickel flows (2005)

- Global model shows material streams in much detail
- Allows to identify “losses” in relevant parts of the value chain
- Shows importance of existing recycling and potential for improving
Global Nickel flows: comparison 2000 & 2005

- In 5 years, global nickel mine production grew by 18%
- Scrap input in fabrication was about 33% of total nickel input

Part 4:

Using MFA for decision making

Recycling efficiencies

- A set of agreed recycling indicators (Yale University, Metals Industry, UNEP...)
- Recycling input rate: 33% - a third of the global nickel supply is from recycling
- EOL recycling rate: 63% - roughly two third of the nickel after its use is recycled

A lot of potential to increase recycling with consumers

Significant losses to slags, tailings

Non-functional recycling relevant for industry

Conclusions for nickel & other metals:

- Real potential for improvement is identified (e.g. UNEP report)
- Areas for improving recycling is shown
- Importance of primary production acknowledged
- Measures are currently debated (e.g. review of EU waste framework directive, recycling certificates)
- Project funding for R&D (e.g. European Innovation Platform)

Growing markets: example of stainless steel in China

- China more than tripled its crude production and end use of stainless steel within 5 years!

Growing markets: example of stainless steel in China

Conclusions:

- Creation of a regional nickel and stainless steel stock requires adequate regional measures
- Development of efficient end of life legislation in China highly important
- Installation of adequate recycling capacities in time is required & relevant also for industry
Future developments: raw materials demand in a low carbon economy

- Leiden University investigated raw material demand linked to low carbon economy
- Various technologies currently are debated
- Conclusion: independant from the technology chosen the demand of certain raw materials will multiply
- Adequate political measures are needed to ensure investment of industry

Part 5:

Conclusions

Conclusion

- Materials flow modeling closes existing data gaps
- Provides stakeholders with important data & information to define adequate measures
  - Political
  - Regulatory
  - Industrial
- The Nickel industry will continue its efforts
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