Integrated stainless steel production in Tornio

Niklas Wass – SVP, Operations Tornio
Welcome to the most integrated stainless steel mill in the world
Safety is our number one priority in all operations

Tornio Operations
Lost time injuries
1/1,000,000 hours
Own personnel and contractors
The plant area and employment

- Tornio Site covers an area of 600 hectares
- > 56 hectares covered with buildings.
- 50 kilometers of roads and 10 kilometers of pedestrian and bicycle routes in the plant area
- 2,100 employees
- 300 contractors
- 7,000 people employed indirectly
Integrated production

- Ferrochrome production onsite with molten Ferrochrome charged directly
- No need to crush or reheat, saving energy and minimizing transportation costs
- Ability to use carbon monoxide from own processing to replace propane as energy source saves costs and CO₂ emissions
- Short processing time and lower logistic costs
- Cost savings from full downstream integration into finished products

- FeCr Production
- Stainless Production

Kemi Mine

Ferrochrome Works

Steel Melt Shop

Hot Rolling Mill

Cold Rolling Mill

Finishing Plant in Terneuzen

End-users and Distributors

Ferrochrome

Black Hot Coils

White Hot Products

Cold rolling in other Outokumpu plants

Other Steel Mills

Outokumpu

6/15/2018
Example products from Tornio

• Direct from Tornio

• Via our plants in Germany
  o Krefeld
  o Dillenburg
OEE improvement of RAP5 with CI initiatives

- **Example 1: Reduction of set-up times**
  - Problem: Value adding production time is lost when changing from one steel grade to another
  - Optimal sequencing defined together with SCM to minimize the non-productive time consumed for set-up between different steel grades.
  - Result: Set-up times reduced by 30% over 16 week period. Effect on OEE +1.6%

- **Example 2: Yield improvement**
  - Problem: To ensure product quality, certain amount of material scrapped from beginning and end of each coil before processing thus creating yield loss
  - Optimal process parameters and ways of working defined to minimize scrapping from head and tail of a coil without compromising quality
  - Result: Improvement of yield by 0.11%, without compromising quality
RAP5 - Weekly OEE has improved on average 11% from 2017

(OEE = Overall Equipment Effectiveness)

2017 AVG 39.0%
2018 AVG 43.4%
Reducing emissions while increasing production

Wastewater discharges: Cr, Ni and Zn

In 2017:
- Discharges of chromium 3.3 kg/d, permit limit value 5 kg/d
- Discharges of nickel 1.6 kg/d, permit limit value 4 kg/d
- Discharges of zinc 3.3 kg/d, permit limit value 4 kg/d
One of the world’s most significant recyclers

Material Balance of stainless steel production 2017

**Materials in**
- Recycled carbon steel 0.35 Mt
- Recycled stainless steel 0.9 Mt
- FeCr-, Ni-, Mo-, Ti, Si-, alloys 0.5 Mt

**Materials out**
- White hot rolled products 0.2 Mt
- Cold rolled products 0.7 Mt
- Mineral products 0.2 Mt
- Waste landfilled and utilized 0.1 Mt

Recycled and recovered metals 0.2 Mt
From chrome ore to stainless steel

Kemi Mine
- Underground mine
- Hoisting
- Crushing
- Grinding
- Spiral concentration

Ferrochrome Works
- Sintering
- FeCr Smelter
- Crushing and screening
- Storage

Steel Melting Shop
- Liquid ferrochrome
- Ferrochrome converter
- Recycled steel
- Electric arc furnace
- AOD converter
- Continuous casting machine

Hot Rolling Mill
- Walking beam furnace
- Roughing mill
- Steckel mill and Tandem mill
- Bell furnaces

Cold Rolling Plant
- Annealing and pickling line
- Sendzimir mills
- Annealing and pickling line
- Polishing line
- Slitting and cut-to-length lines
- Coils and sheets

RAP-line
- Continuous rolling-annealing-pickling line

Logistics
- Coils and sheets
- Transportation
- Customers

Terneuzen
- Slitting and cut-to-length lines
- Coils and sheets
- Customers

6/15/2018