Agglomeration Seminar NyKoSi

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Trondheim – NORWAY

EURAGGLO – KOMAREK
ROLLER PRESSES:
Applications in the fields of carbon, metallurgy and steel-mills
Introduction

**Agglomerate and granulate**

**Agglomeration**

Process consisting in particles size enlargement carried out on finely divided solids with the use of pressure, agitation or heat.

**Granulation**

Agglomeration of a finely divided solid into granules of various sizes by a process involving agitation (WET GRANULATION). This word also applies to COMPACTION-GRANULATION process using pressure (dry granulation).
The different bond types in the agglomeration processes

- **a. Bindings with material bridges**
  - a1. Chemical reaction
    - Sintering
    - Partial fusion
  - a2. Absorption layers
  - a3. Liquid bridges
    - Binder bridges
  - a4. Particle interpenetration

- **b. Bindings without material bridges**
  - b1. Molecular forces
    - Van der Waals forces
  - b2. Electrostatic forces
  - b3. Magnetic forces
  - b4. Free Valence forces
    - (chemical links, ...)
The different agglomeration processes

1. Processes using **agitation** or « snow balling » effect in wet conditions without the use of external forces or pressure

**Agitation agglomeration**

- Pelletizing discs or deep drums
- Granulation drums
- Mixers-granulators
- Fluidized beds
- Atomizers

**WET PROCESSES**
The different agglomeration processes

2. Processes using pressure with weak, average or high external forces.

Pressure agglomeration

• **Roller presses or compactors**
• Flat or circular die pellet presses
• Hydraulic presses
• Tabletting presses

DRY OR SEMI-WET PROCESSES
Pressure Agglomeration

ROLLER PRESSES
APPLICATIONS IN THE CARBON AREA

• Low-rank coals- Binderless briquetting for transport to power plants
• Anthracite mixes- Home heating
• Iron ore or other metallic oxides with carbon to feed furnaces
• Specific high volatiles low ash coals for activation
• Blends of non-coking + coking coals to feed coke plants
• Charcoal briquetting to produce barbecue briquette, activated carbon, serve as reducer in metallurgical plants (alone or in addition to metallic oxides...)
• Carbon (coke, anthracite...) mixed to millscales for recycling
Delivery of Low Rank Coal Based Energy
Drying & Binderless Briquetting of LRC

Key Process Steps

1. Raw Coal w/ High Water Content and Low Energy Value
2. Sizing for More Homogenous and Easy Dewatering
3. Dewatering to Increase Energy Value
4. Briquetting to form lumped coal
5. Stabilizing for Reduced EQM and Minimal Spontaneous Combustion
Drying & Binderless Briquetting of LRC

1. Raw Coal
2. Screen
3. Crusher
4. Feeder
5. PC Air Heater
6. Fluid Bed Dryer
7. Air Fan
8. Circulating Fan
9. Cyclone
10. Classifier
11. Surge Bin Conveyor
12. Grinding Mill
13. Distribution Bin
14. Briquette System
15. Bin
16. Stabilizer
17. Upgraded Coal

Crushing 100
Drying 200
Briquetting 300
Stabilizing 400
Dried and Briquetted Low Rank Coal with High Heating Value
Requirements for carbon-based raw materials for briquetting

• Size range
• Moisture content
• Hardness / wettability
• Shape of particles
Choice of binders for carbon briquetting

- Price
- Availability
- Environmental aspects
- Process complexity
- Final use of briquettes

Binderless briquetting is only used for specific coals with very particular maceral analyses, mostly from the sub-bituminous or bituminous families.
## Coal Briquetting Possible Processes

### Binder

- Resin + hardener + green strength additive (GSA)
- Molasses + Hydrated lime
- Molasses + Phosphoric Acid + GSA
- Lignosulfonate
- Starch (with or without additive)
- Bitumen, pitch

### +

- Cold cure system
- No requirement for heat treatment
- Cold cure system (but might require some heat after briquetting)
- Low cost binder
- Good end briquettes
- Can be cold used with additives...
- Very good end briquettes
- Easy to use binder
- Very good waterproof briquettes

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- Smell upon ignition
- Poor waterproof properties unless coated
- Smell upon burning
- Require post-treatment for curing
- But generally need a post treatment
- Sulfur addition
- Require post treatment for drying/curing
- Aromatic content if not cured after briquetting
- Health issues around use of these binders in a plant
Example of Euragglo design capability: A petroleum coke briquetting plant

- Capacity: 40 MTPH
- Construction in 2008/2009
- Installed in Navodari-Romania
Flow Diagram
General Lay-Out
Typical Process
Flow-diagram

Coal Briquetting
Lime/Molasses
Typical Process
Flow-diagram
Coal Briquetting
Bitumen
A Coal Briquetting Unit
Drying and Briquetting Zones
The feeding and drying zones
The drying zone
The mixing
The roller press
Press DH500

Capacity: 50 MTPH of coal briquettes
Main Applications of Roller-Press Briquetting for Steel-Mill By-products

Mill scales
Dried sludges
Filter dust (EAF..)
Steel grits
DRI fines
Crushed spent refractories

All fines and dusts of raw materials can generally be briquetted with a binder, provided they are dried to a moisture content below 2% and with a controlled amount of free quick lime (CaO)
Recycling Steel Mill Waste to Recover Valuable Iron
By-products in the steel-mill area

Residues touched by agglomeration

- wide range of chemical composition
- tonnages from 5 kt/y to 200 kt/y per plant

- Blast furnace dust & sludge: 10 kg/t
- Converter dust & sludge: 20 kg/t
- Oily sludge: 1-3 kg/t
- Electric furnace dust (stainless): 20 kg/t
- Iron oxydes, hydroxides, miscellaneous sludge
Briquetting: one example

Plant at Isbergues (France) for the treatment of stainless dust & sludge

Miscellaneous stainless dust and sludge

Reception

Briquetting

Dryer

Briquetting press

Production - storage

Electric furnace

Production 70 KT/an
Process of Waste Iron Oxide Briquetting

- Wet Blending
- Dry Dust
- Additives
- Dried Blends
- Dryer
- Binder Addition
- Stage I Mixer
- Stage II Mixer
- Conveying
- Screen
- Briquette Press
- DRI-Zinc Recovery
- Steel Making Charge
- Briquette Piles
Typical Feed and Product Specifications

Binder Specification
- Binder: Molasses
- Sugar Content: > 45%
- Solid Content:
- Temperature: > 35 °C

Waste Oxide Feed Specification
- Feed Materials:
  - Steel making dust, sludge
  - Coal or coke fines
- Particle Sizes: < 3 mm
- Bulk Density: > 1200 kg/m³
- Moisture: < 5%

Waste Oxide Briquette Specification
- Briquette Shape: pillow shape
- Briquette Volume: 9 cm³
- Briquette Weight: 21 g
- Briquette Sizes: 40 x 30 x 22 mm
Agglomeration of steel-mill by-products

Main parts of the briquetting plant:
- The preparation of the raw materials including eventual drying, hydration of lime, crushing, dosing..
- The storage and dosing of the binders (generally molasses, hydrated lime, lignosulphonates, cold cured binders..)
- The mixing unit (batch or continuous)
- The briquetting unit with the screening of the briquettes
- The storage of briquettes for the curing before use
Example of briquetting unit 10 T/h (Spain)
Example of briquetting unit

Arcelor Mittal - FRANCE
Recycling of EAF Dust with RHF to Recover Zinc Oxide-ZincOx Recycling Plant in South Korea
View of roller press
Waste oxide briquettes
Example of 35 MTPH briquetting plant for dried sludges

**Arcelor Mittal France**

- **Batch mixing**: sludges and other by-products
- **Binder**: Molasse + Lime (+ cement)
- **Press type DH450-36**
  - Roll diameter: 915 mm
  - Roll width: 385 mm
  - Gravity feed
  - Total force: 200 Tonnes
Pockets in Briquetting rolls
Segmented tyres
Segmented Tyres
HARSCO
CORUS TATA
Scunthorpe UK
HARSCO
CORUS TATA
Scunthorpe UK
Main applications of roller-press briquetting for the metallurgical area

- Metallic ores + oxides (Chromite, manganese ore, copper concentrates, nickel ...)
- Metal fines (nickel, chromium, cobalt ...)
- Ferro alloys (FeMn, FeCr, FeSi, SiMn..)
- Silicon carbide
- Lime/Dololime + additives (Al, Fe..)
Example: Agglomeration of Nickel Laterite

Main parts of the briquetting plant:
- The preparation of the raw materials including eventual drying, crushing, dosing
- The mixing unit, batch or continuous (coal, dust, recycling, recipe of laterite)
- The briquetting unit with the screening of the briquettes
- The storage of briquettes before use (if needed)
Nickel Laterite

Example of a Multiple-press Plant
Nickel Laterite

Example of a Multiple-press Plant
Key points:

- Stability of raw materials is key to success of briquetting/granulation plants (size-range, moisture content...)
- Choice of binders (technical + economic) will influence choice of adequate mixing system
- R&D steps before plant selection are key to understand raw material behaviour during agglomeration process and mechanical characteristics of finished agglomerates
- Large range of presses/compactors is necessary to cover requirements in terms of capacity (Lab, Scale-up industrial, industrial..), feed method (to the rolls), required briquetting/compaction force, etc.
K.R. KOMAREK GROUP
EURAGGLO
Briquetting and Granulation specialists

Worlwide capabilities

• R&D in pilot plants (USA, France, Argentina, Australia, South Africa)
• Audit of existing plants to improve process and/or maintenance
• Engineering of briquetting and granulation system
• Large know-how based on many industrial references
THANK YOU!

TUSEN TAKK!