Agglomeration Seminar NyKoSi

22-23 November, 2016
Trondheim – NORWAY

EURAGGLO – KOMAREK ROLLER PRESSES:

Applications in the fields of carbon, metallurgy and steel-mills

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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. **a. Bindings with material bridges**

b. **Bindings without material bridges**

a.1 

a 1. Chemical reaction
Sinterising
Partial fusion

b1. Molecular forces
Van der Waals forces

a.2 

Absorption layers

b.2 

b2. Electrostatic forces

a.3 

Liquid bridges
Binder bridges

b3.Magnetic forces

a.4 

Particle interpenetration

b.4 

B4. Free Valence forces (chemical links ,...)

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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

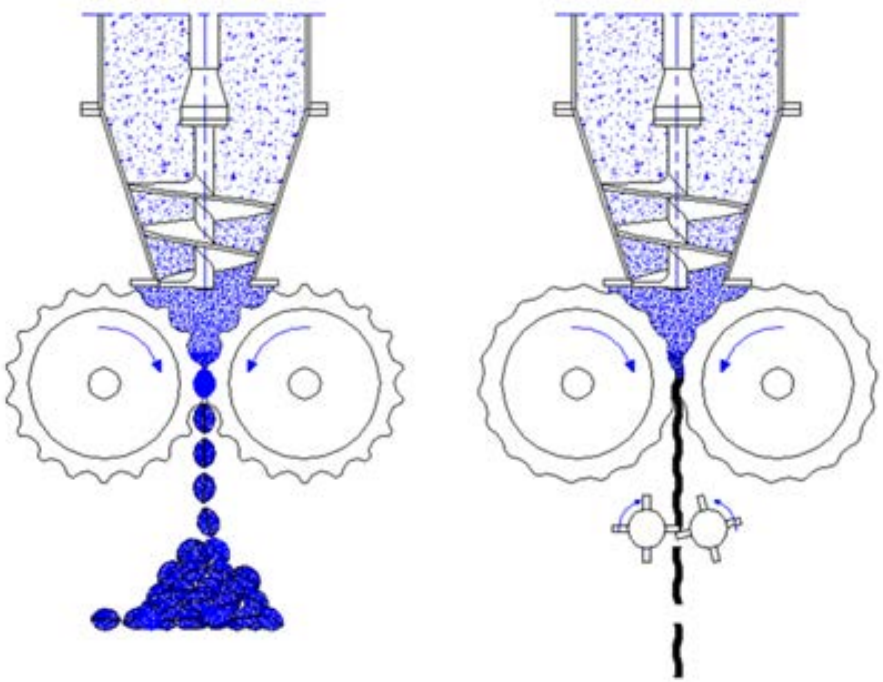
2.Processes using pressure with weak, average or high external forces.

Pressure agglomeration

- **Roller presses or compactors**
- Flat ot circular die pellet presses
- Hydraulic presses
- Tabletting presses

DRY OR SEMI-WET PROCESSES

Pressure Agglomeration



ROLLER PRESSES

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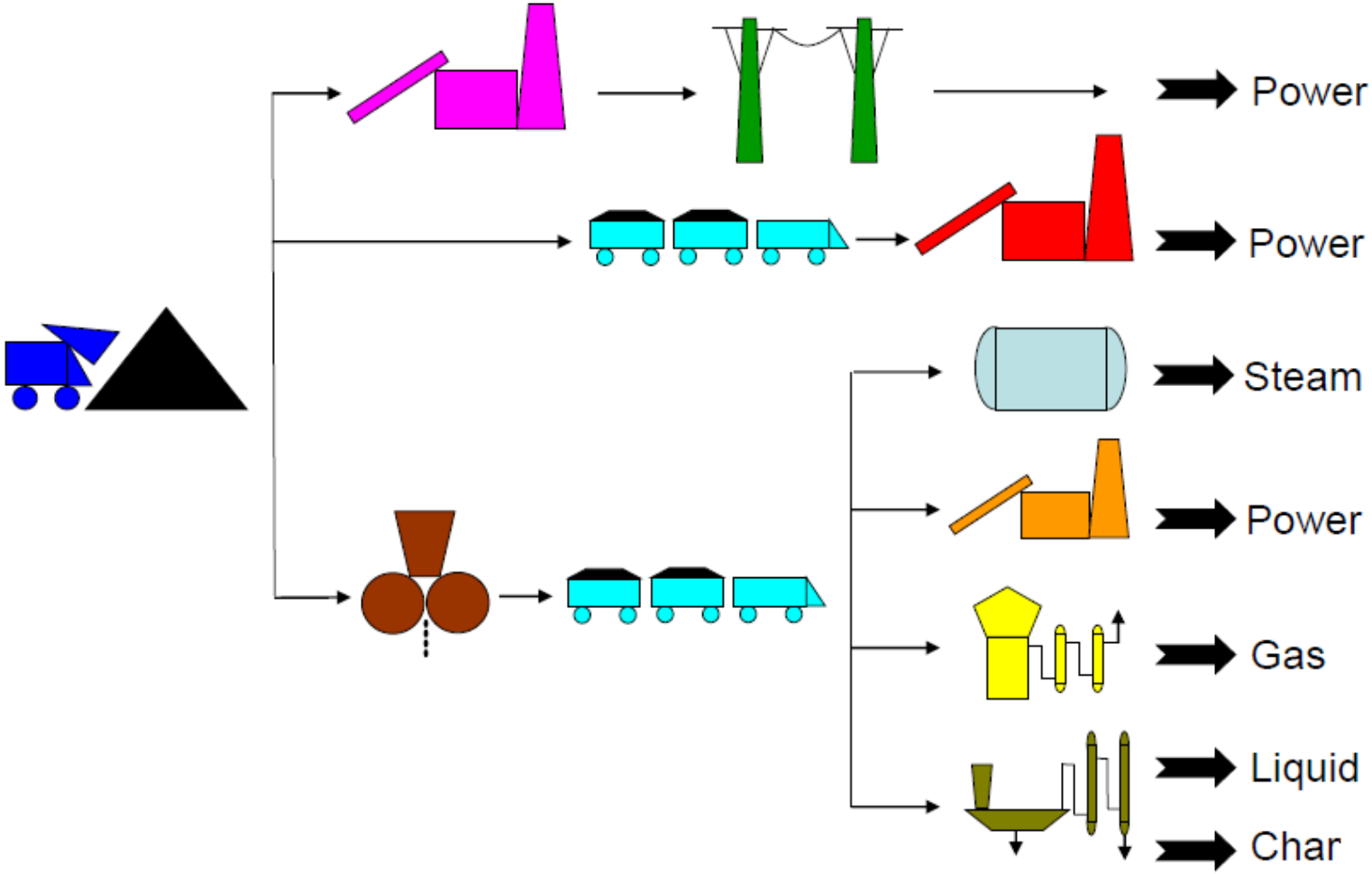
APPLICATIONS IN THE CARBON AREA

- 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



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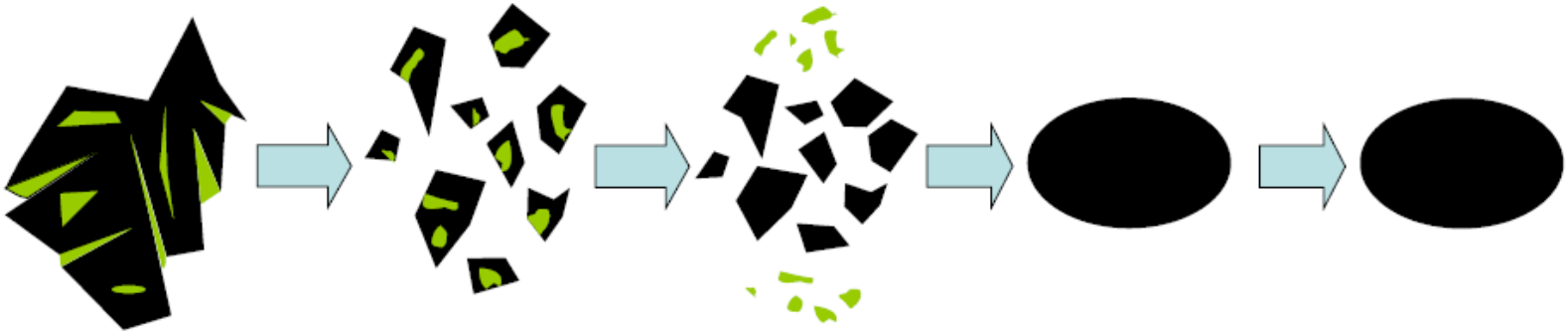
Drying & Binderless Briquetting of LRC

Key Process Steps



Raw Coal w/ High Water Content And Low Energy Value

Sizing for More Homogenous and Easy Dewatering

Dewatering to Increase Energy Value

Briquetting to form lumped coal

Stabilizing for Reduced EQM and Minimal Spontaneous Combustion

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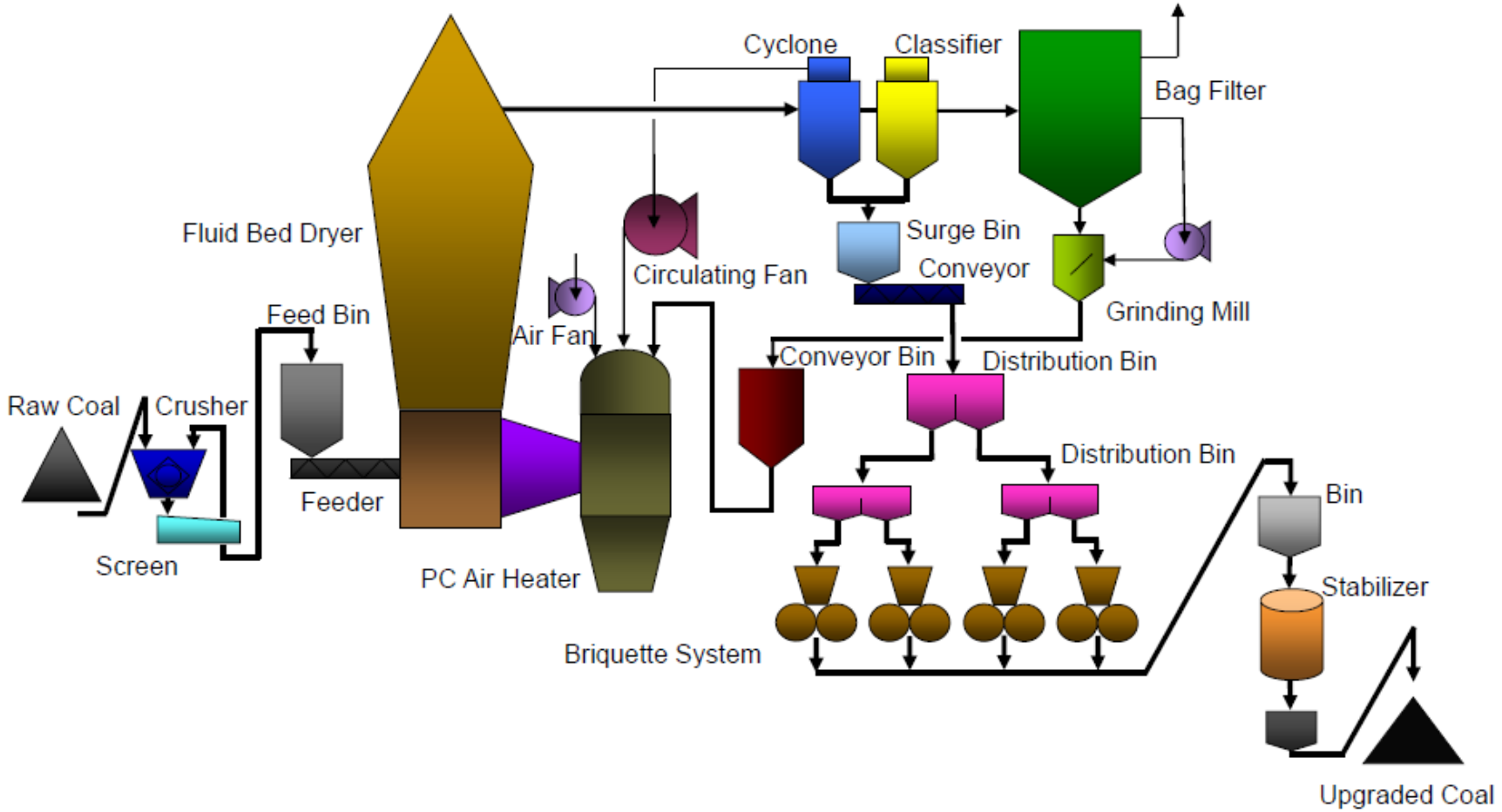
Drying & Binderless Briquetting of LRC



Crushing 100 **Drying 200** **Briquetting 300** **Stabilizing 400**

Dried and Briquetted Low Rank Coal with High Heating Value

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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-bitumonous or bituminous families.

Coal Briquetting Possible Processes

Binder	+	-
• Resin + hardener + green strength additive (GSA)	• Cold cure system • No requirement for heat treatment	• Smell upon ignition
• Molasses + Hydrated lime	• Cold cure system (but might require some heat after briquetting) • Low cost binder	• Poor waterproof properties unless coated • Smell upon burning
• Molasses +Phosphoric Acid + GSA	• Good end briquettes	• Require post-treatment for curing
• Lignosulfonate	• Can be cold used with additives... • Very good end briquettes	• But generally need a post treatment • Sulfur addition
• Starch (with or without additive)	• Easy to use binder	• Require post treatment for drying/curing
• Bitumen, pitch	• Very good waterproof briquettes	• 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

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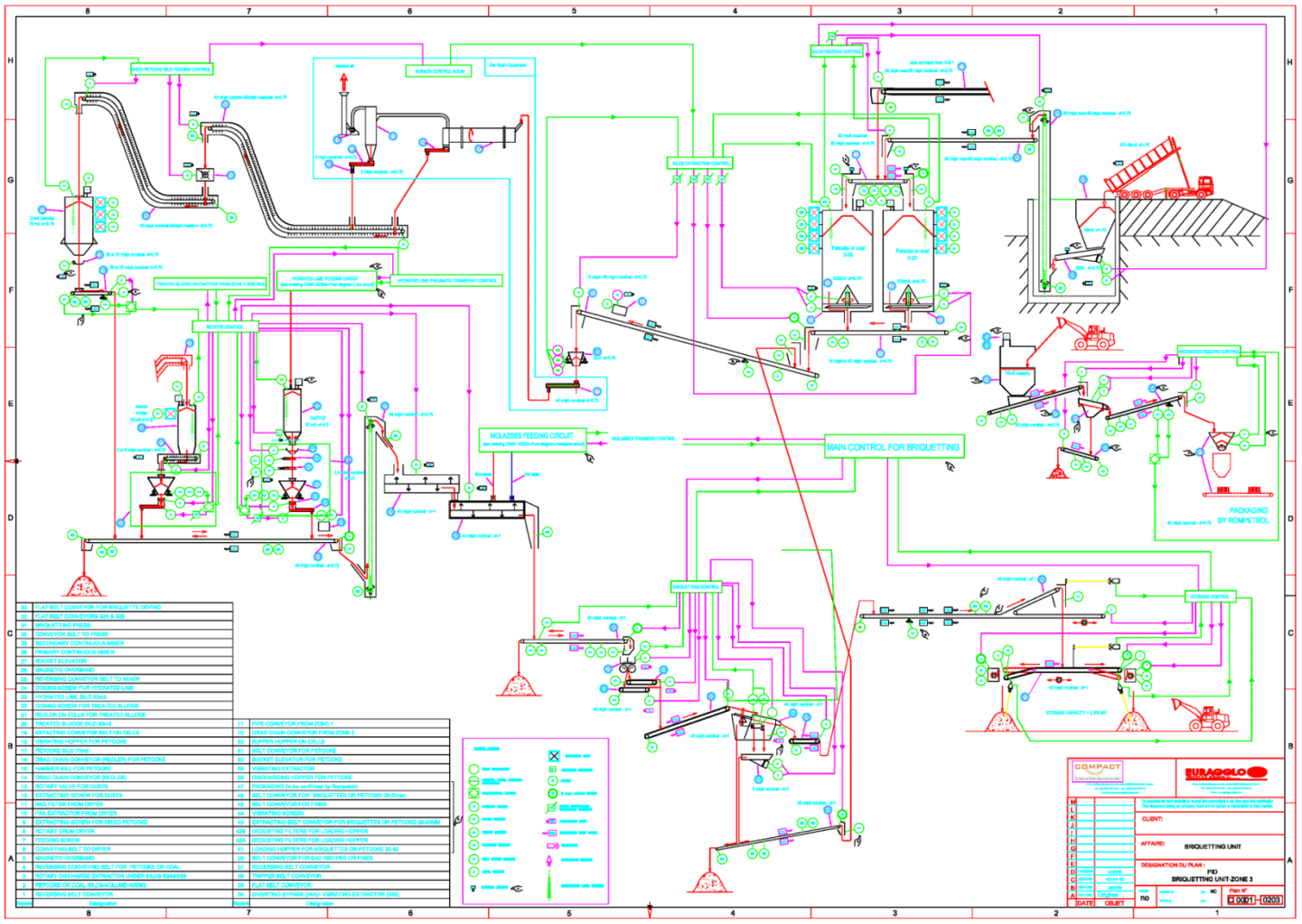

Flow Diagram

Systems

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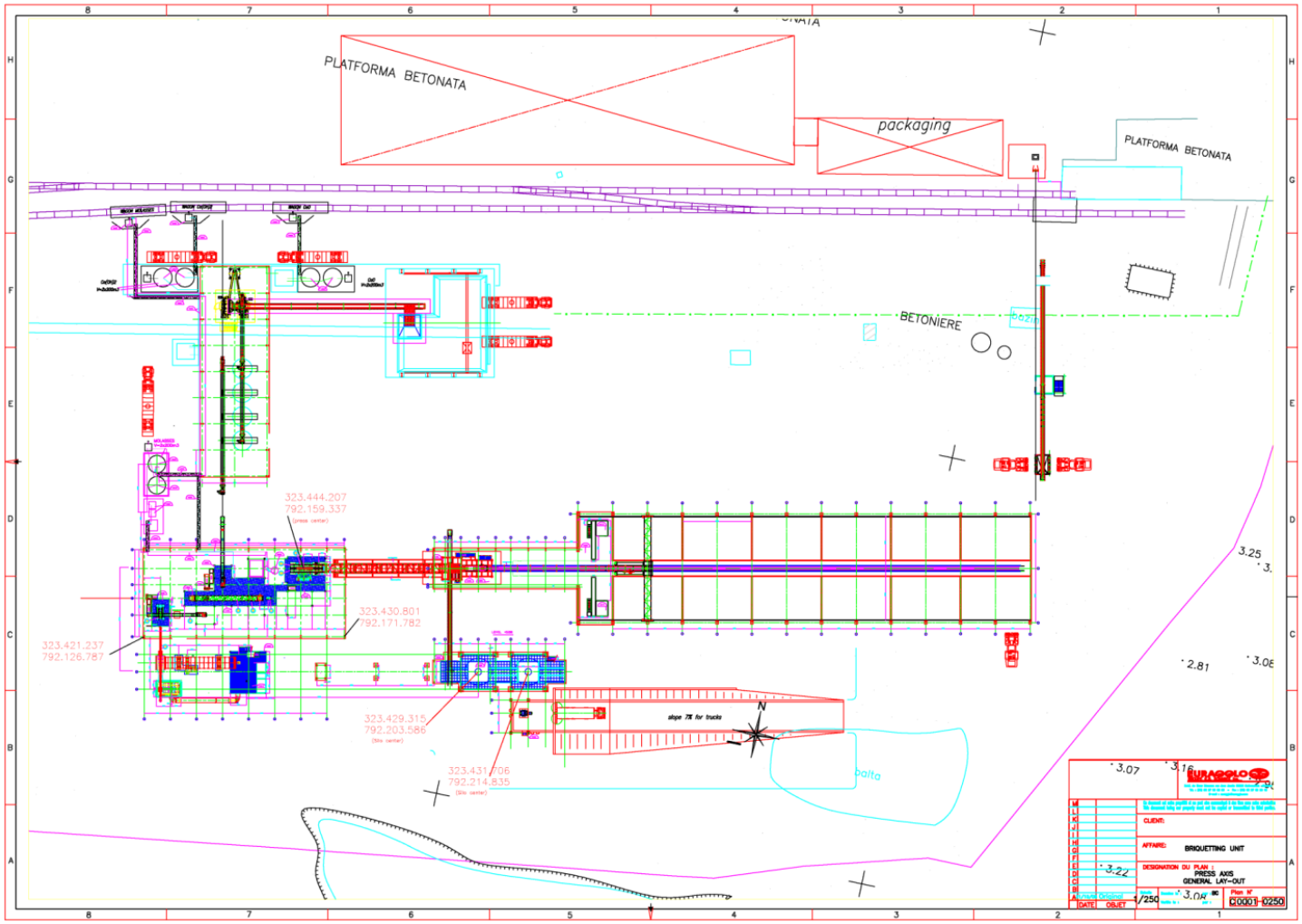
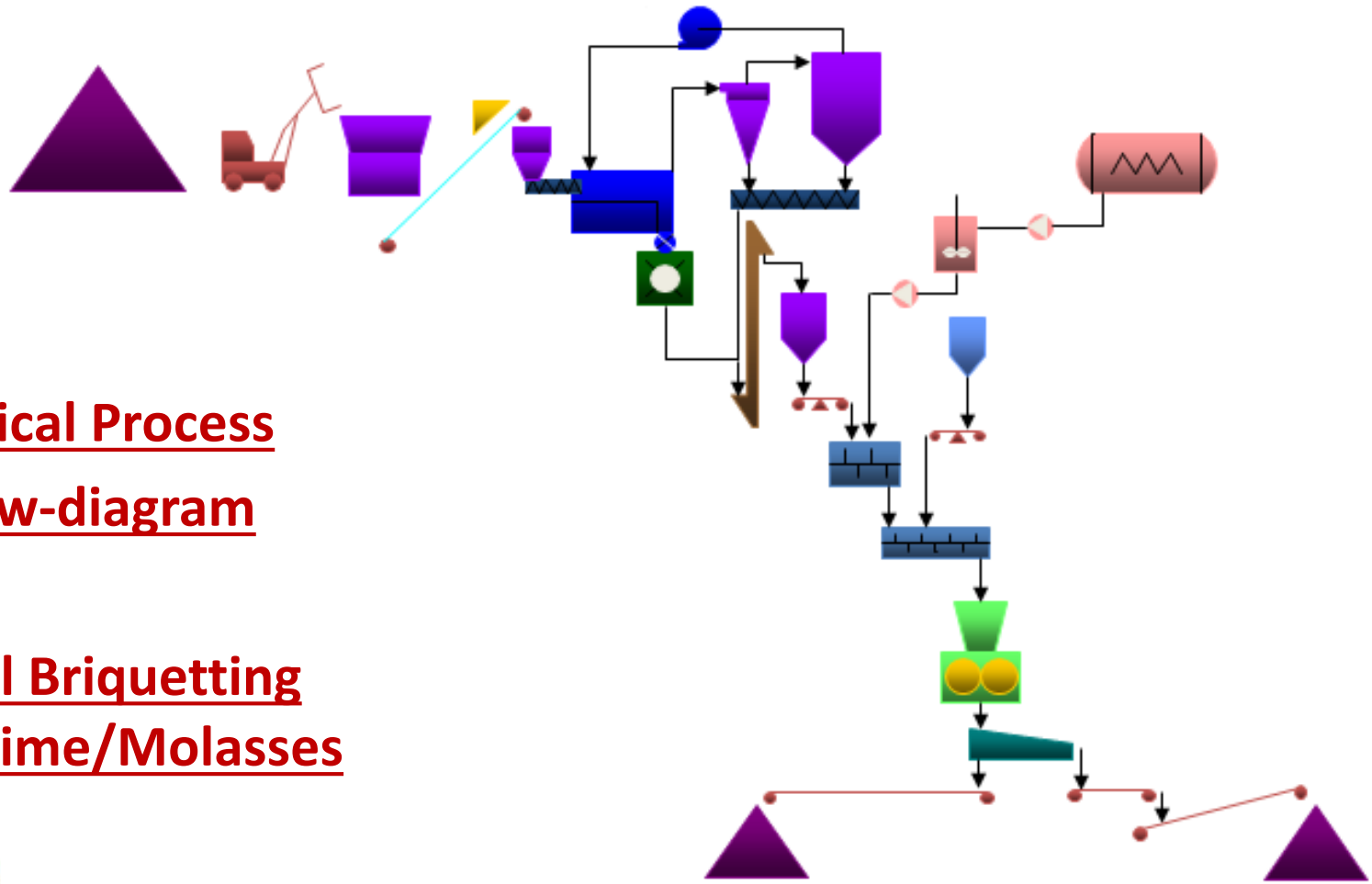


General Lay-Out



Typical Process Flow-diagram

Coal Briquetting Lime/Molasses

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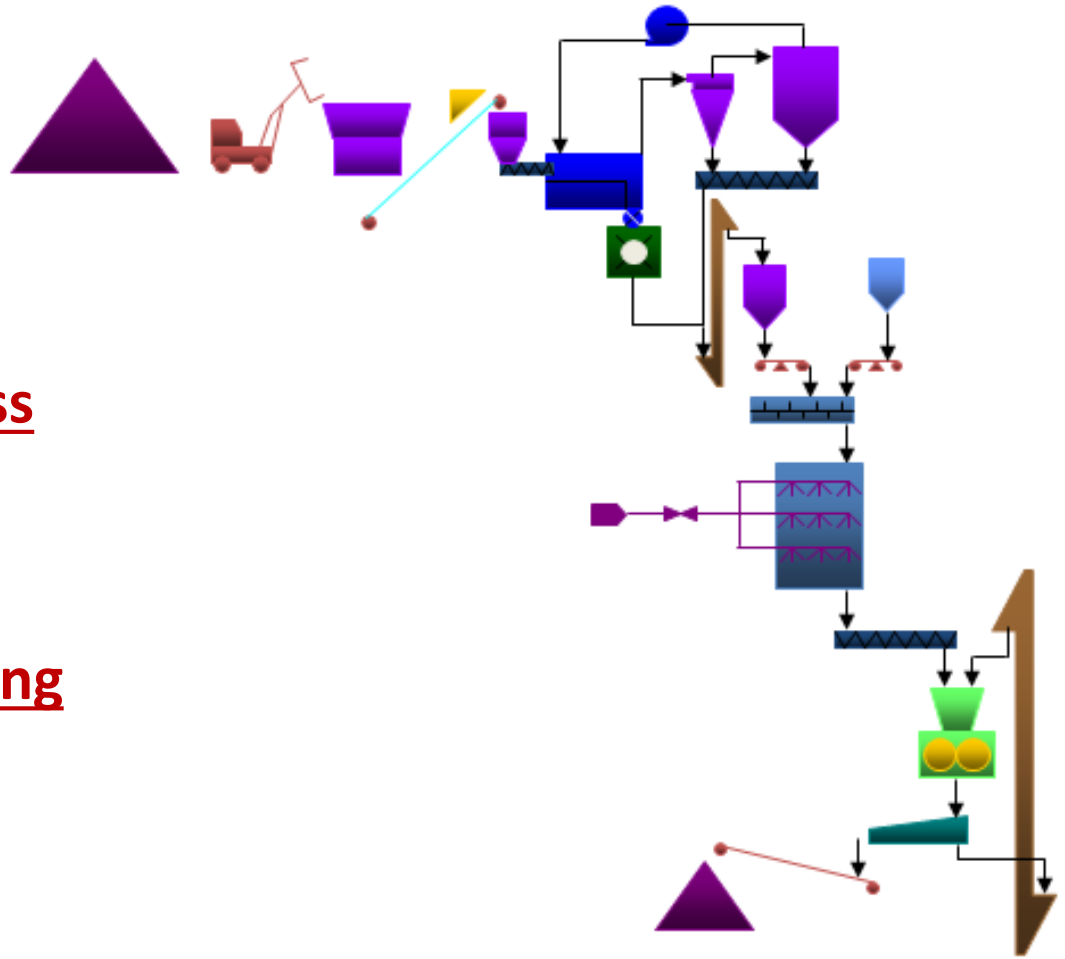

Typical Process Flow-diagram

Coal Briquetting Bitumen

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A Coal Briquetting Unit

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Drying and Briquetting Zones

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The feeding and drying zones

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The drying zone

The mixing

The roller press

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Press DH500

Capacity: 50 MTPH of coal briquettes

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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

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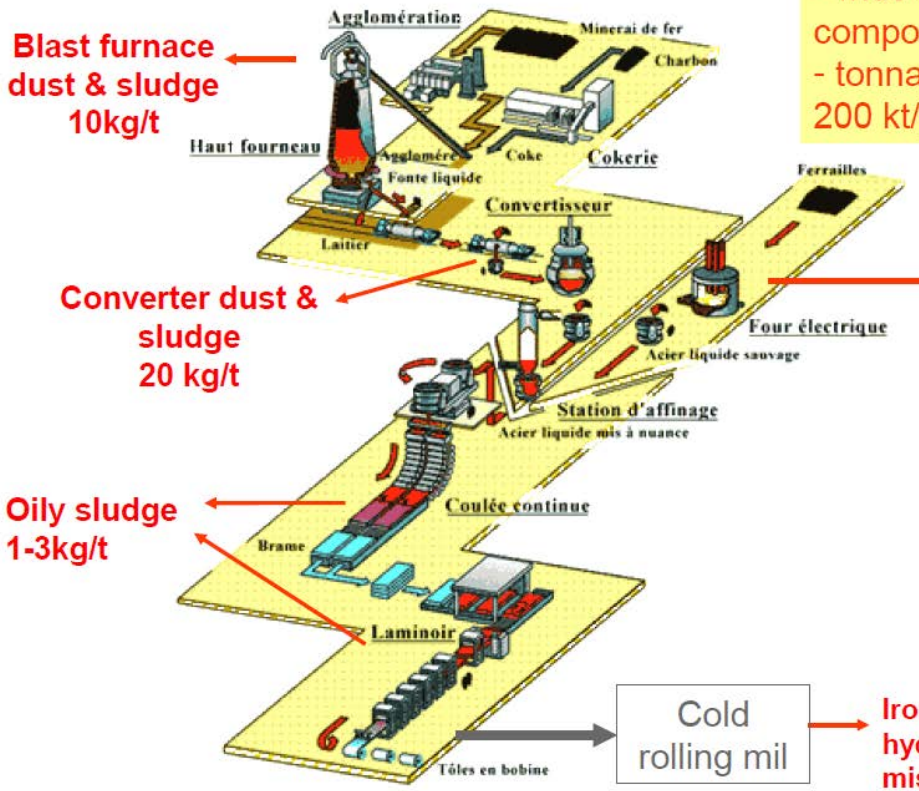
By-products in the steel-mill area

Residues touched by agglomeration

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



Blast furnace dust & sludge 10kg/t

Converter dust & sludge 20 kg/t

Electric furnace dust (stainless) 20 kg/t

Oily sludge 1-3kg/t

Cold rolling mil → Iron oxydes, hydroxydes, miscellaneous sludge

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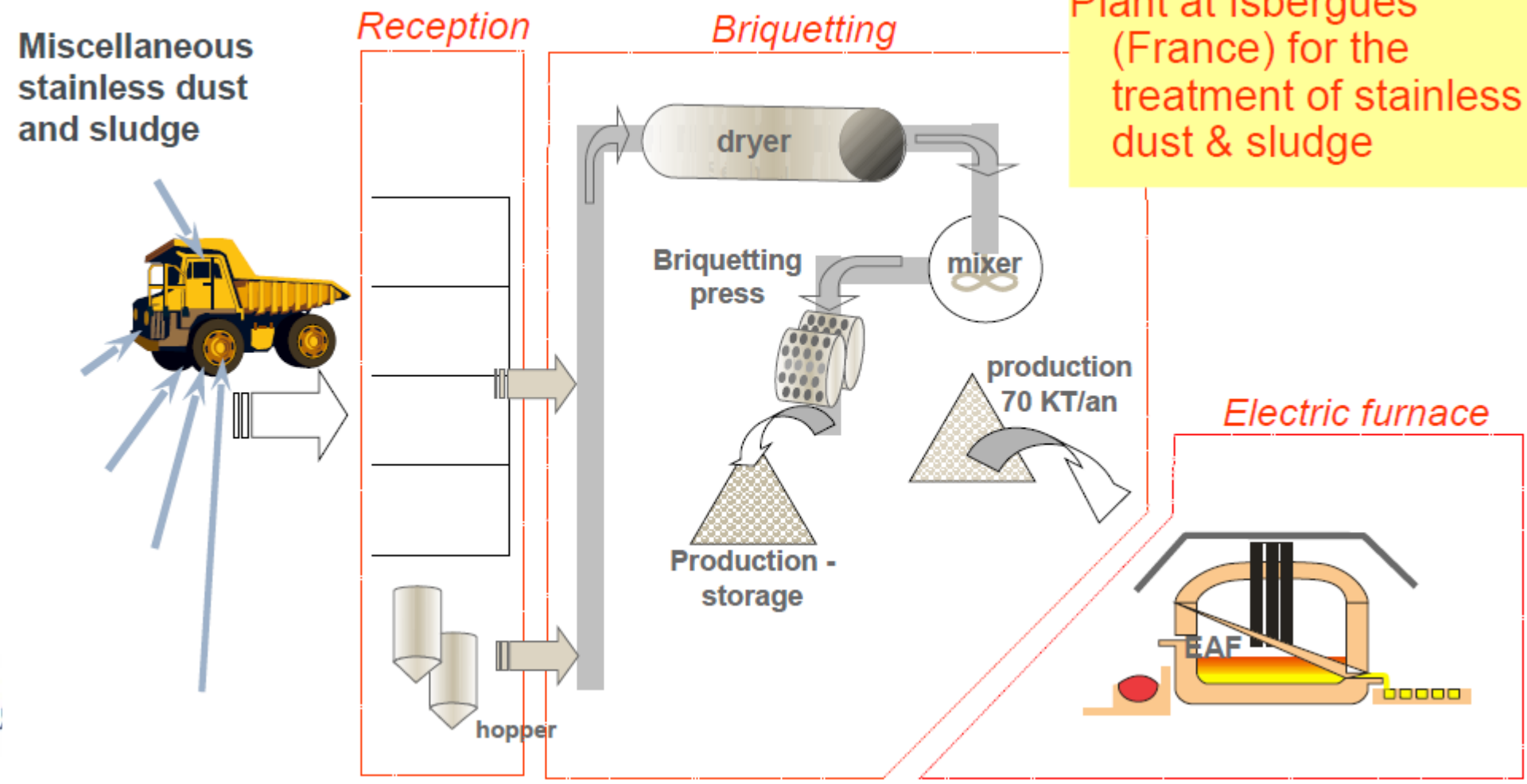
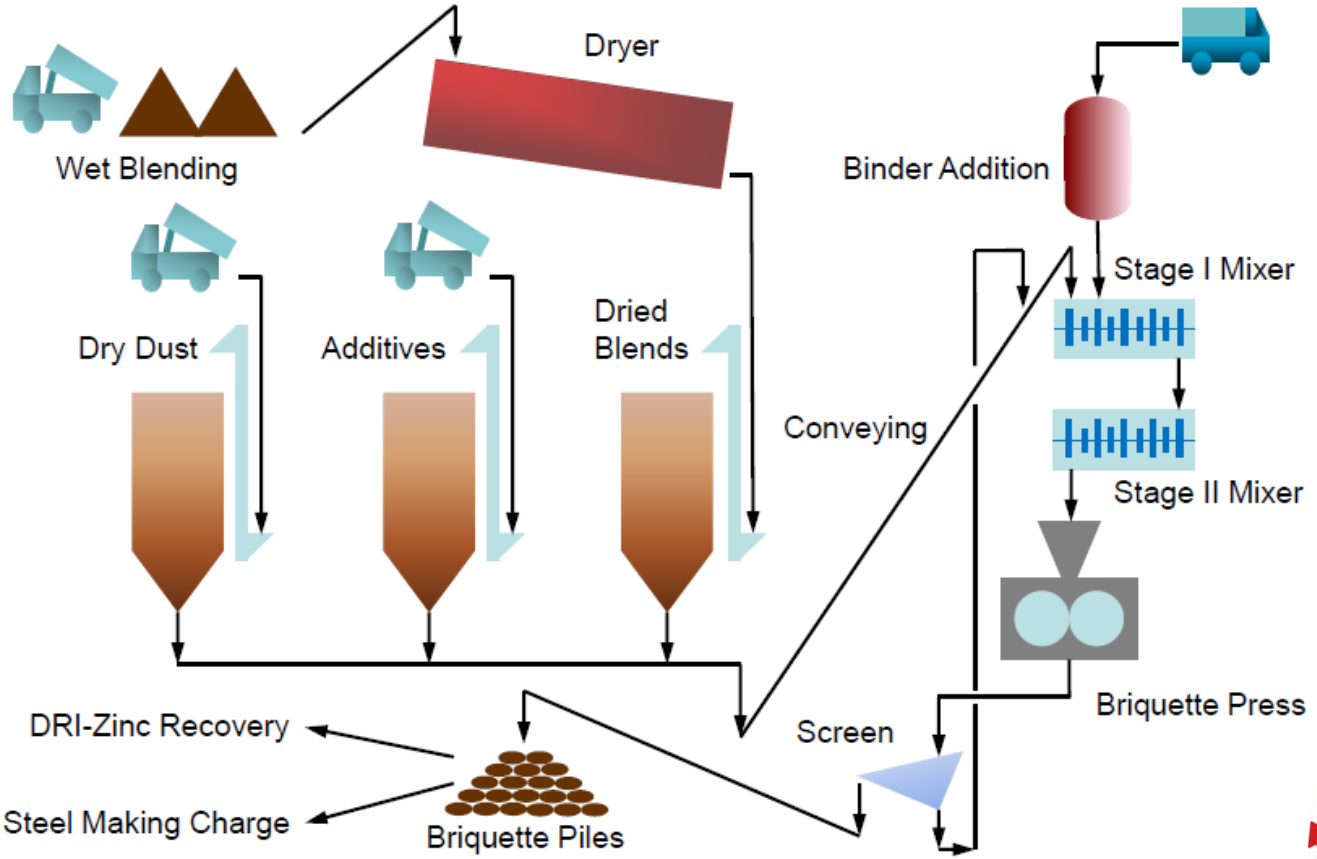
Briquetting: one example

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



Process of Waste Iron Oxide Briquetting



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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/m^3
- Moisture: < 5%

Waste Oxide Briquette Specification
- Briquette Shape: pillow shape
- Briquette Volume: 9 cm^3
- Briquette Weight: 21 g
- Briquette Sizes: 40 x 30 x 22 mm

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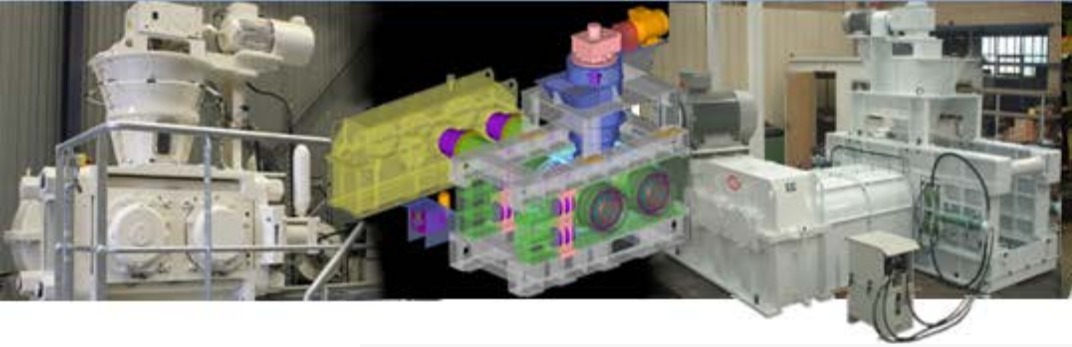
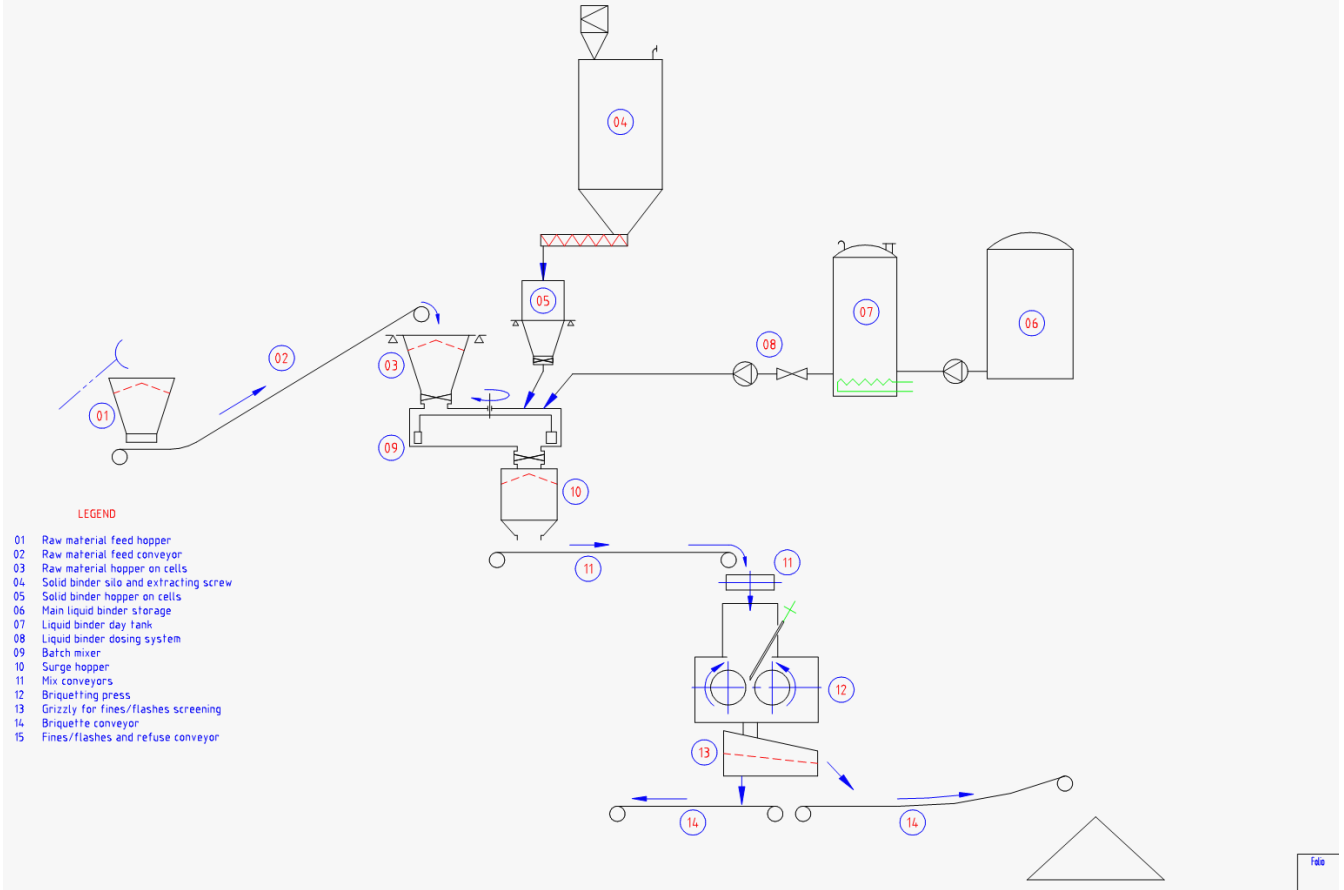
Agglomeration of steel-mill by-products

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 ot continuous)
- The briquetting unit with the screening of the briquettes
- The storage of briquettes for the curing before use





LEGEND

01	Raw material feed hopper
02	Raw material feed conveyor
03	Raw material hopper on cells
04	Solid binder silo and extracting screw
05	Solid binder hopper on cells
06	Main liquid binder storage
07	Liquid binder day tank
08	Liquid binder dosing system
09	Batch mixer
10	Surge hopper
11	Mix conveyors
12	Briquetting press
13	Grizzly for fines/flashes screening
14	Briquette conveyor
15	Fines/flashes and refuse conveyor

Folio

EURAGGLO GROUPE S.A. KOMAREK Inc.

BRIQUETTING UNIT
TYPICAL FLOW-SHEET

N°
N°
3472

Indc | Indcat | Tira

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Example of briquetting unit 10 T/h (Spain)

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Example of briquetting unit

Arcelor Mittal - FRANCE

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Recycling of EAF Dust with RHF to Recover Zinc Oxide-ZincOx Recycling Plant in South Korea

DH500 Briqueter

Sludge Dryer

Zinc Oxide Recovery

Rotary Hearth Furnace (RHF)

Briquettes To RHF

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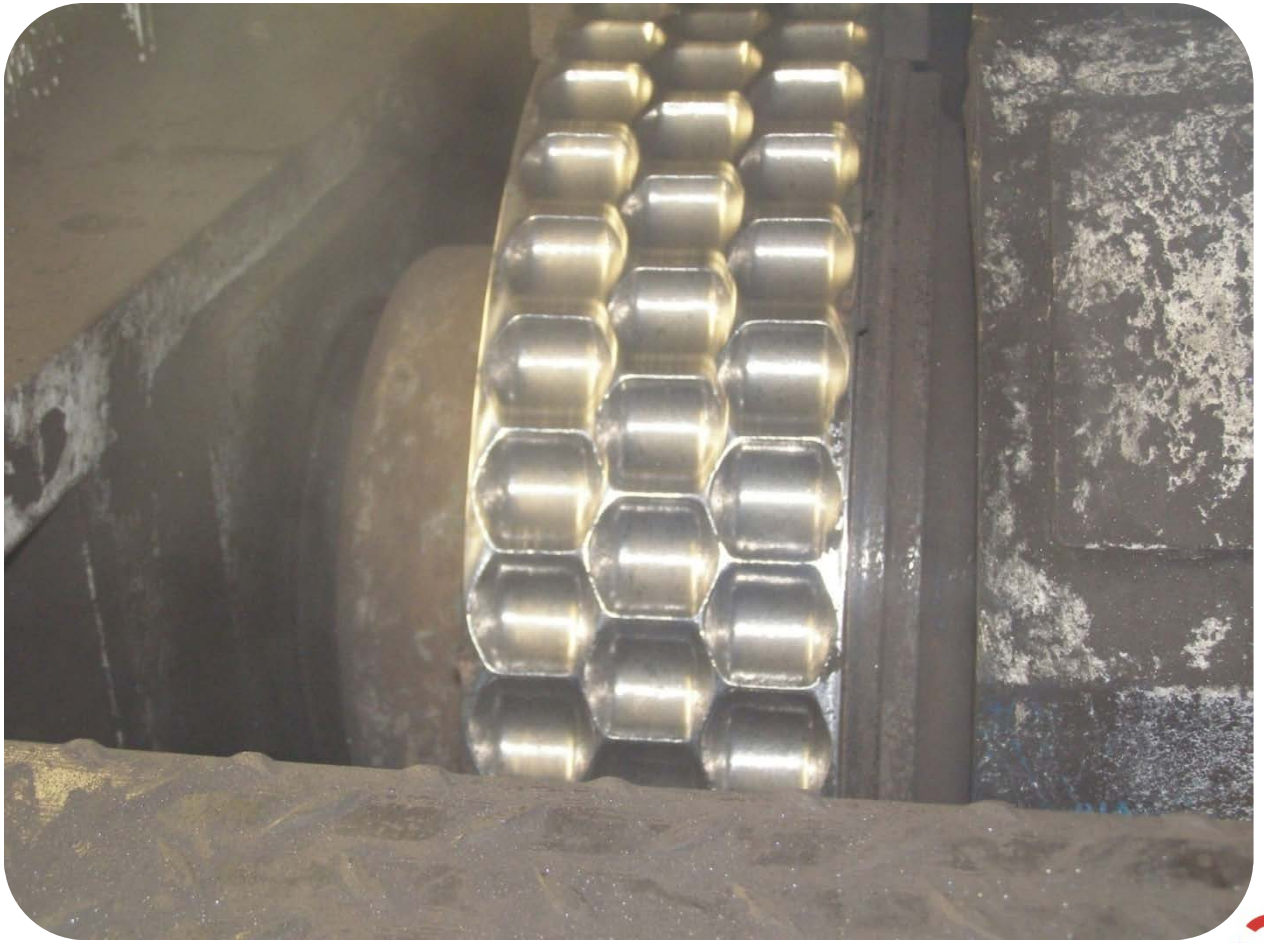
View of roller press



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Waste oxide briquettes

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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

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Briquetting Press
DH450-36

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Pockets in Briquetting rolls

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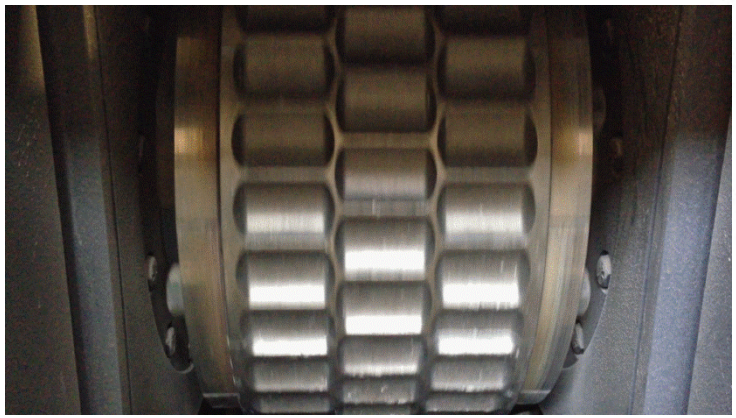
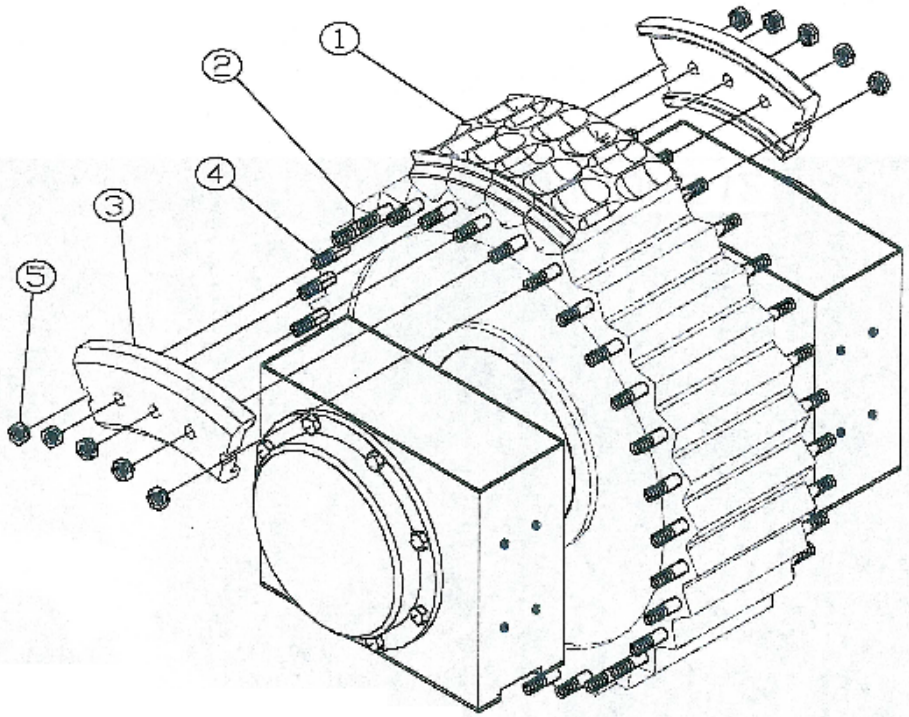
Segmented tyres





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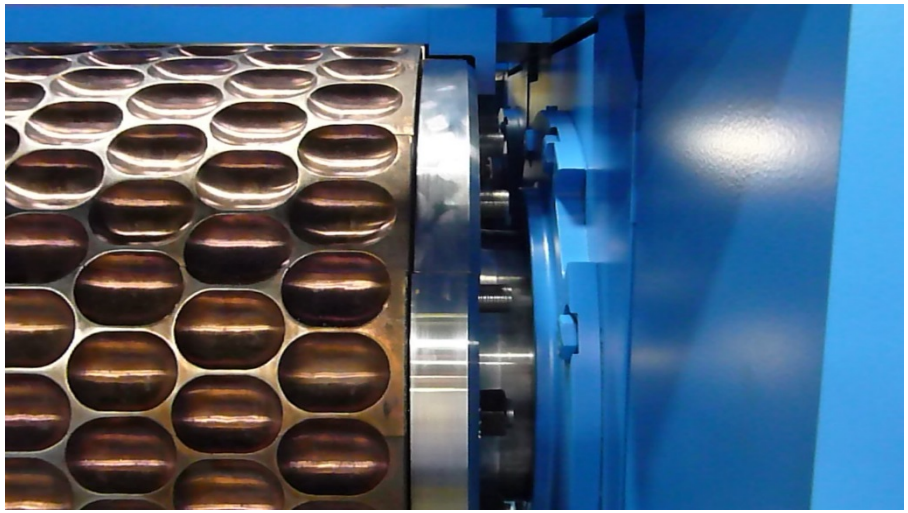

Segmented Tyres

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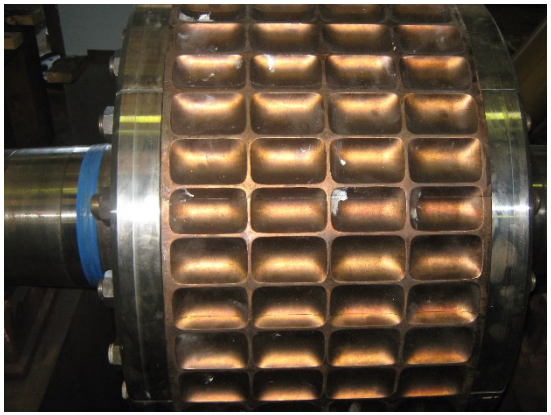

Various Press Rollers

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HARSCO

CORUS TATA

Scunthorpe UK

HARSCO

CORUS TATA

Scunthorpe UK

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Main applications of roller-press briquetting for the metallurgical area

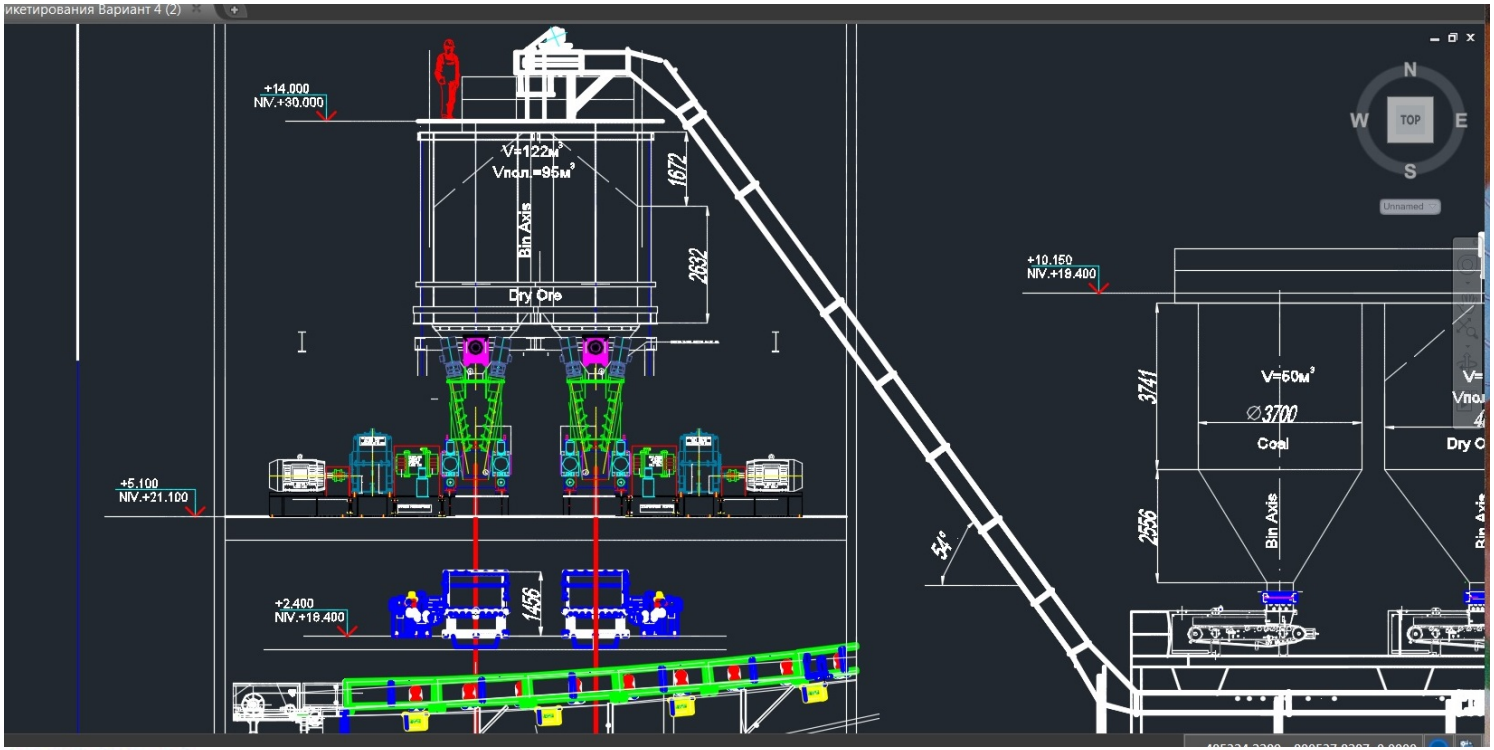
- Metallic ores + oxides (Chromite, manganese ore, copper concentrates, nickel …)
- Metal fines (nickel, chromium, cobalt …)
- Ferro alloys (FeMn, FeCr, FeSi, SiMn..)
- Silicon carbide
- Lime/Dololime + additives (Al, Fe..)

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



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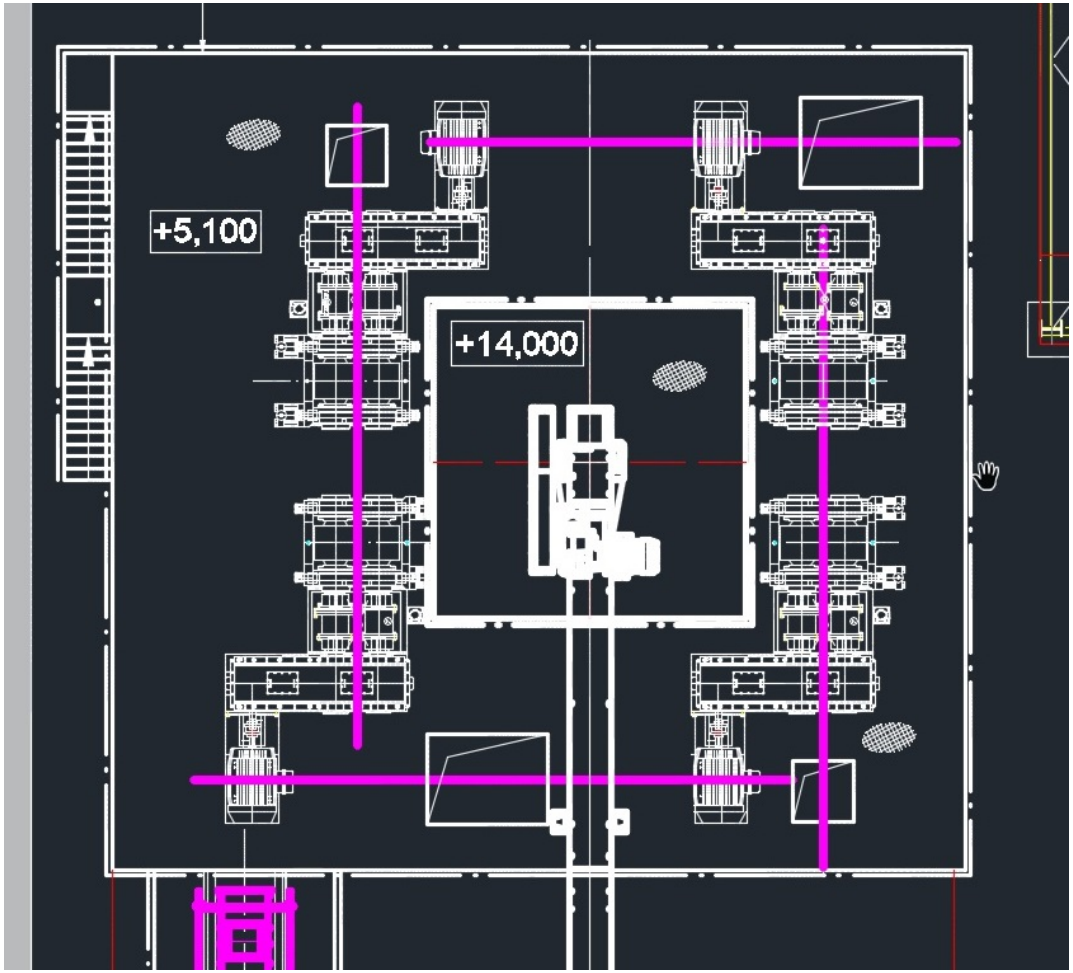
Nickel Laterite

Example of a Multiple-press Plant



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Roller - Presses

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..

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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

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THANK YOU!

TUSEN TAKK!

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