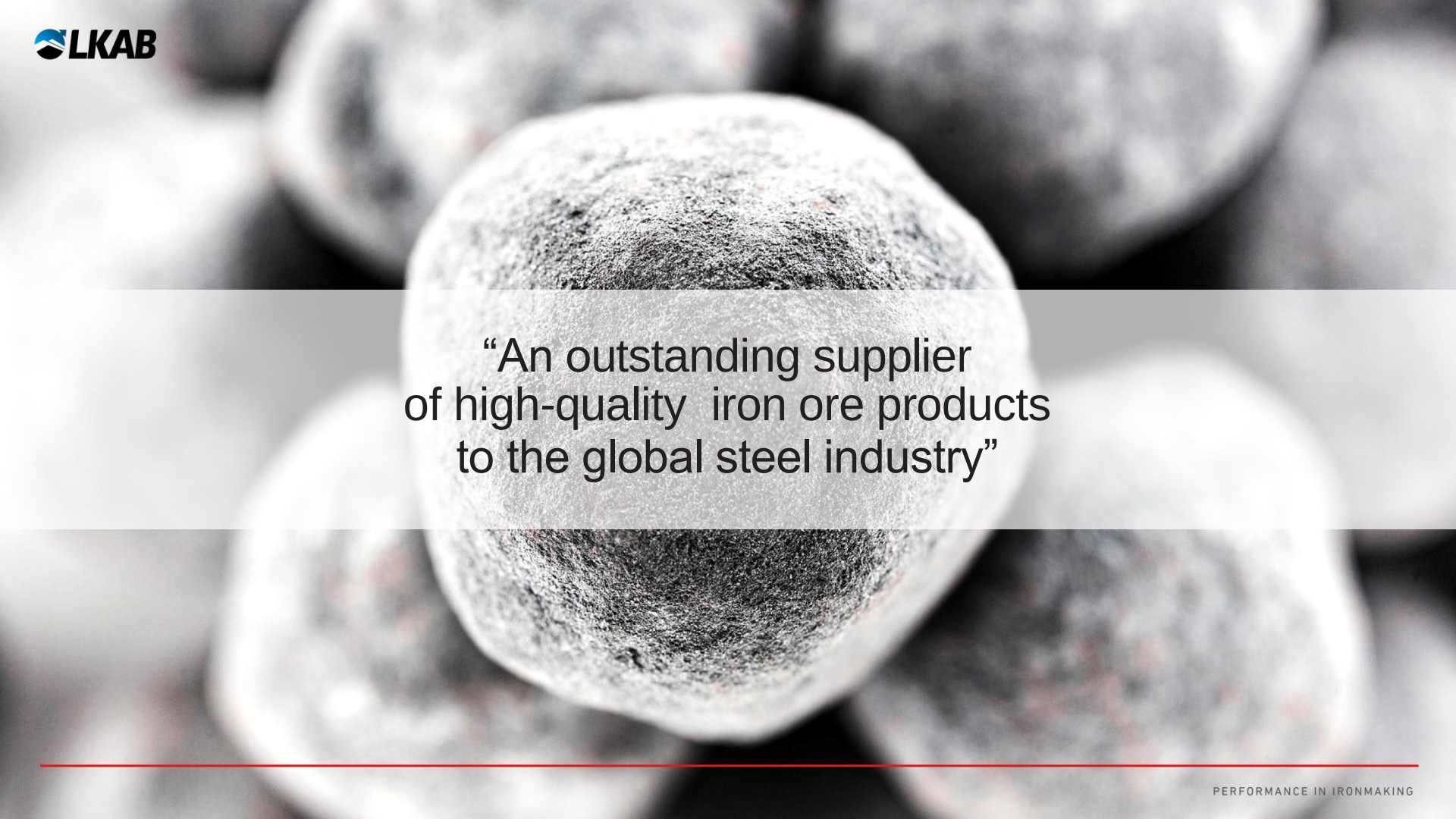
FRESH THINKING
IRON ORE PELLET PRODUCTION AT LKAB

Agglomeration Seminar NyKoSi, Trondheim

Kent Tano

Principal R&D Expert


“An outstanding supplier
of high-quality iron ore products
to the global steel industry”

EUROPE'S LEADING PELLET MANUFACTURER

EUROPE

LKAB is the EU's largest iron ore producer and mines around 76 PERCENT of all iron ore in the EU

90%
of LKAB's revenue comes from pellet sales

3
LKAB is the world's 3rd largest producer of iron ore pellets

125 YEARS
LKAB is one of Sweden's oldest industrial companies and has customer relationships dating back more than a century

4,500
Around 4,500 employees in total

16,2 SEK bn
Net sales of SEK 16,2 billion in 2015

100% LKAB is a 100% state-owned company

BASED IN THE SWEDISH OREFIELDS

FIND LKAB

FINES

PELLETS

OUR PRODUCTION SITES

Summary:

POSITIONING FOR A MARKET IN CHANGE

Requires us to be highly competitive

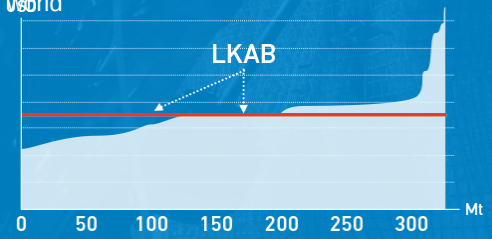
A SIGNIFICANT SUPPLIER IN A SPECIALISED MARKET

HIGH QUALITY PRODUCTS GET A HIGHER MARKET PRICE

CAPACITY IN MINES, INFRASTRUCTURE AND LOGISTICS

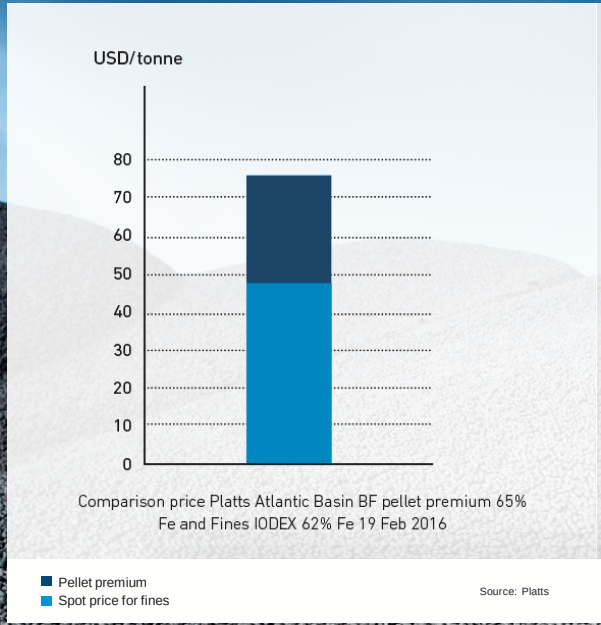
PRODUCT PORTFOLIO THAT SUPPLEMENTS THE PELLET STRATEGY

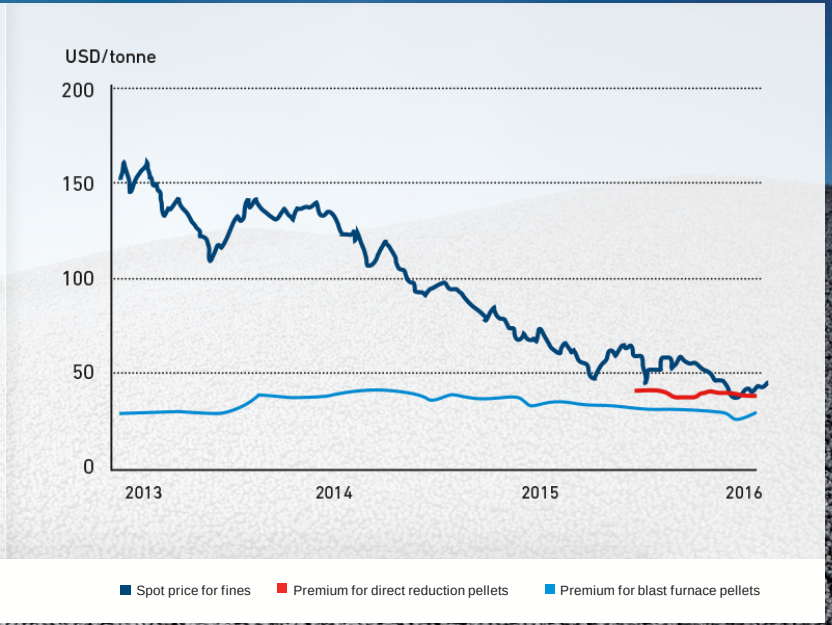
Cash cost – pellet producers around the world



HIGHER MARKET PRICE FOR PELLETS

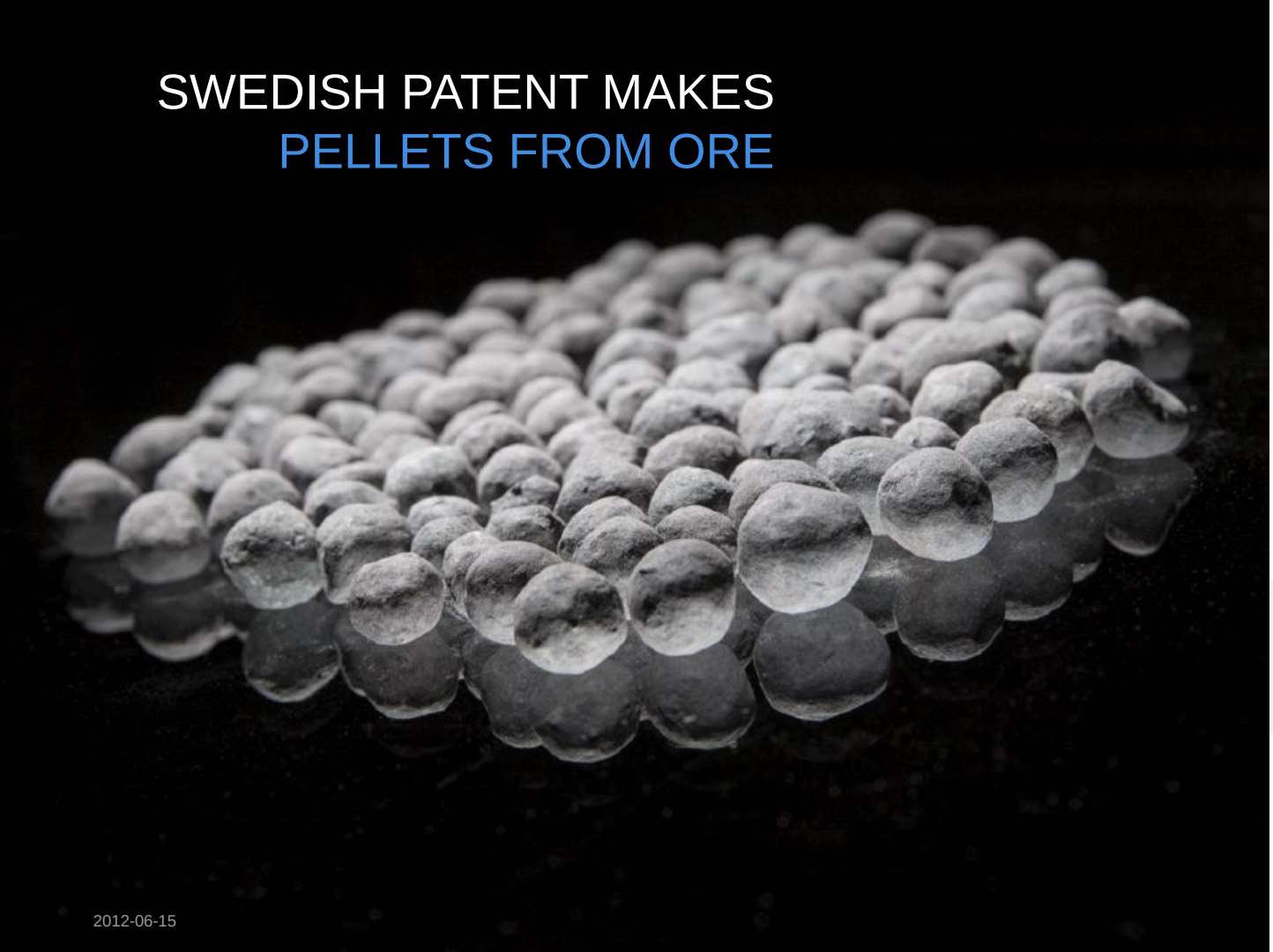
The pellet premium appears strong relative to the spot price for fines





Source: Platts

SWEDISH PATENT MAKES PELLETS FROM ORE



During the post-war period of the 50s, there was a strong belief in the future. It was in this period of optimism that LKAB decided to begin producing pellets based on the so called sintering method. The origins of the method come from a patent taken out by A G Andersson in 1912, 1955 thus saw the opening of Europe's first pellet plant.

OLIVINE PELLETS – A MAJOR SUCCESS STORY FOR LKAB

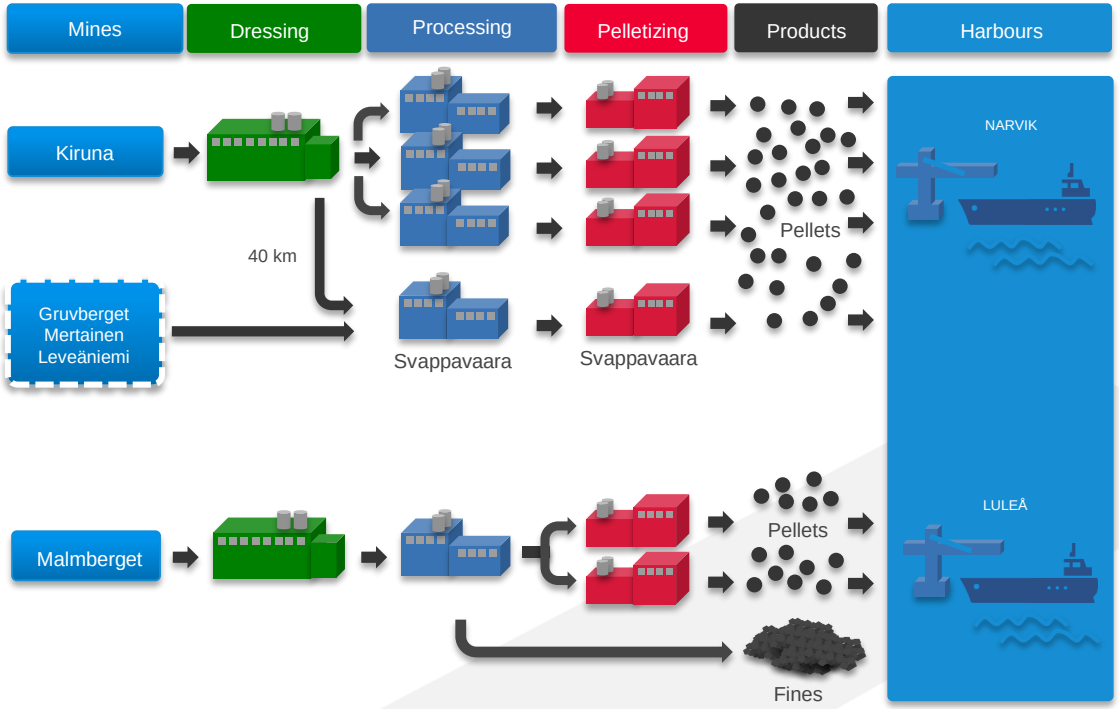
- ✓ **The goal was to find a formula for pellets that could improve and increase the efficiency of the blast furnace process.**

- ✓ **The innovation was an immediate success. Fuel consumption in the furnace dropped by over 7%, and the rest is history. Olivine pellets have become LKAB's greatest sales success in modern times.**

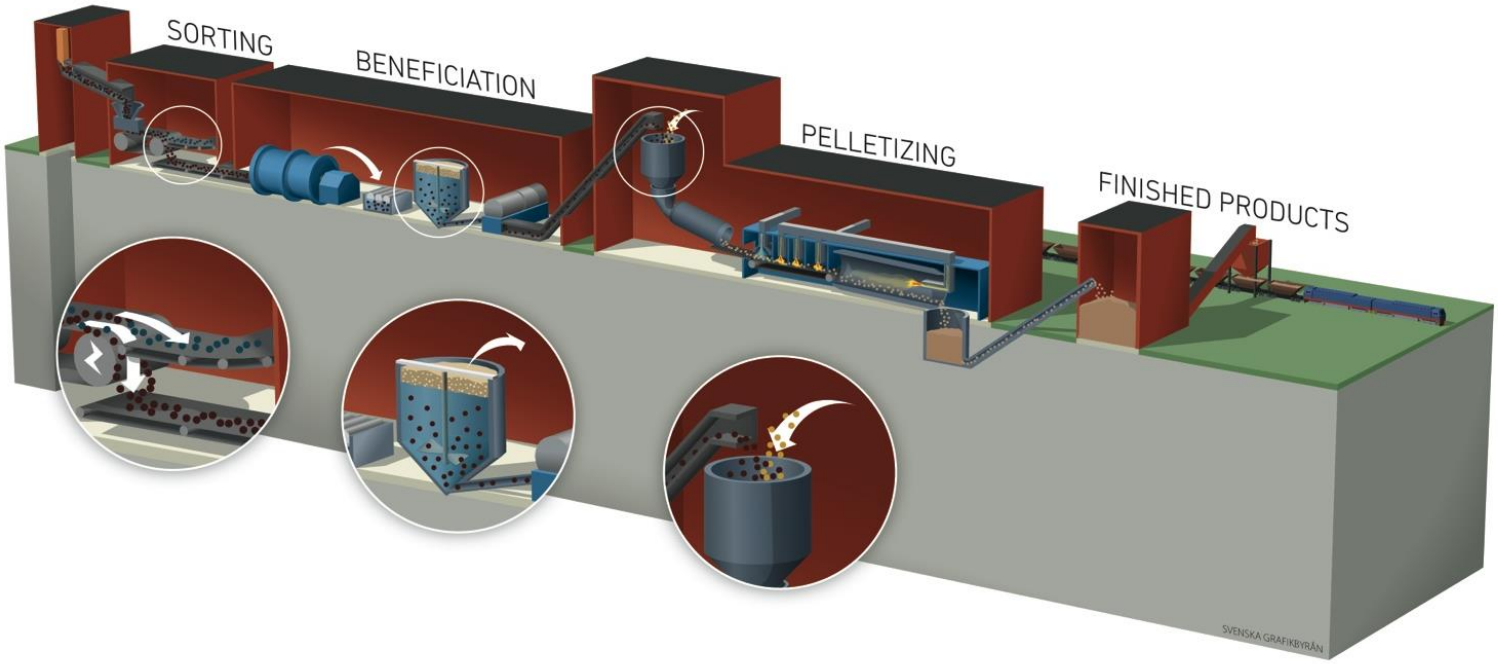
THE GLOBALLY UNIQUE EXPERIMENTAL BL AST FURNACE

- ✓ **The success of olivine pellets showed that LKAB's interest in how the raw material behaved in their customers processes was the right approach.**

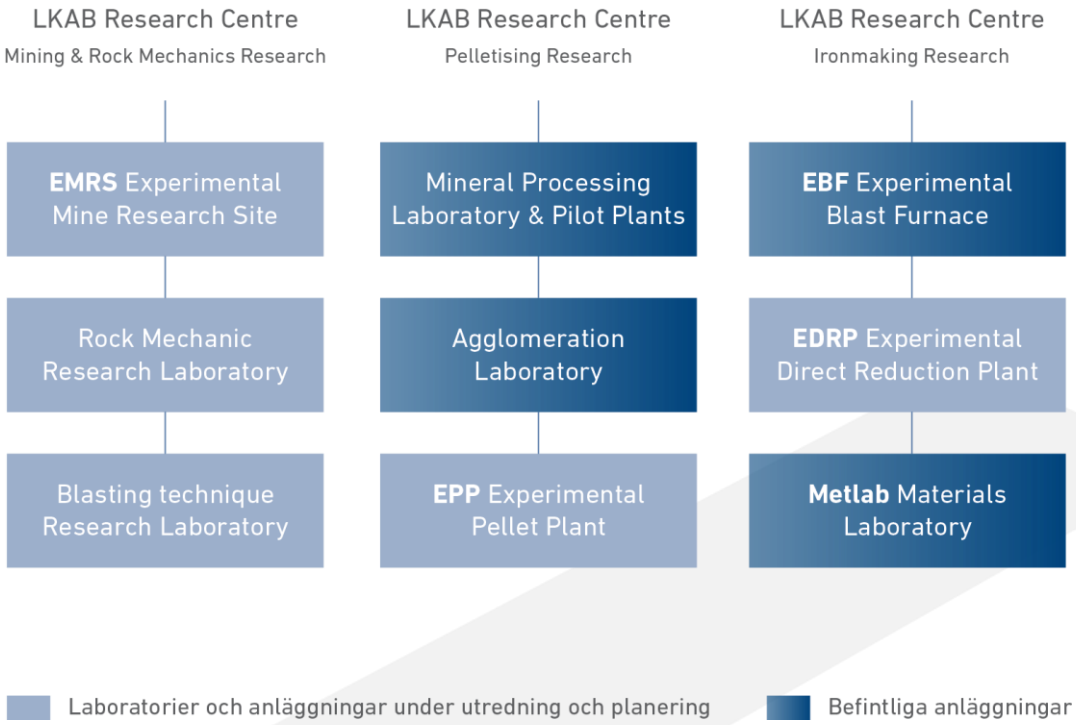
PRODUCTION STRUCTURE



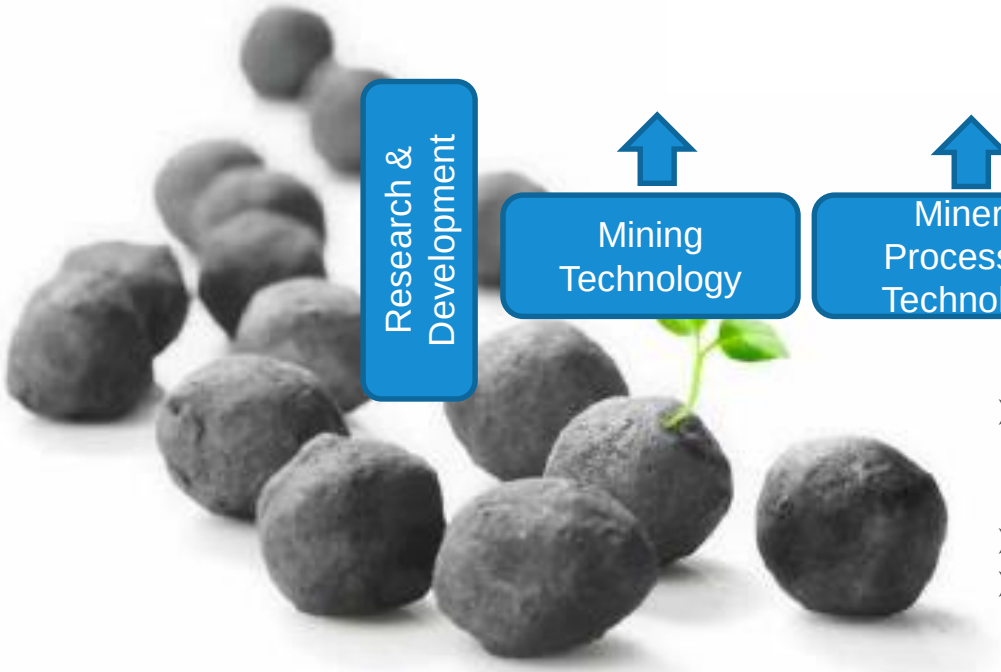
FROM ORE TO FINISHED
IRON ORE PRODUCTS



R&D INFRASTRUCTURE
LABORATORIES AND DEMONSTRATORS



R&D ORGANISATION



Production Process
Crude ore → Concentrate → Green Pellets → Sintered Pellet

Iron Making Process

Research & Development

Mining Technology

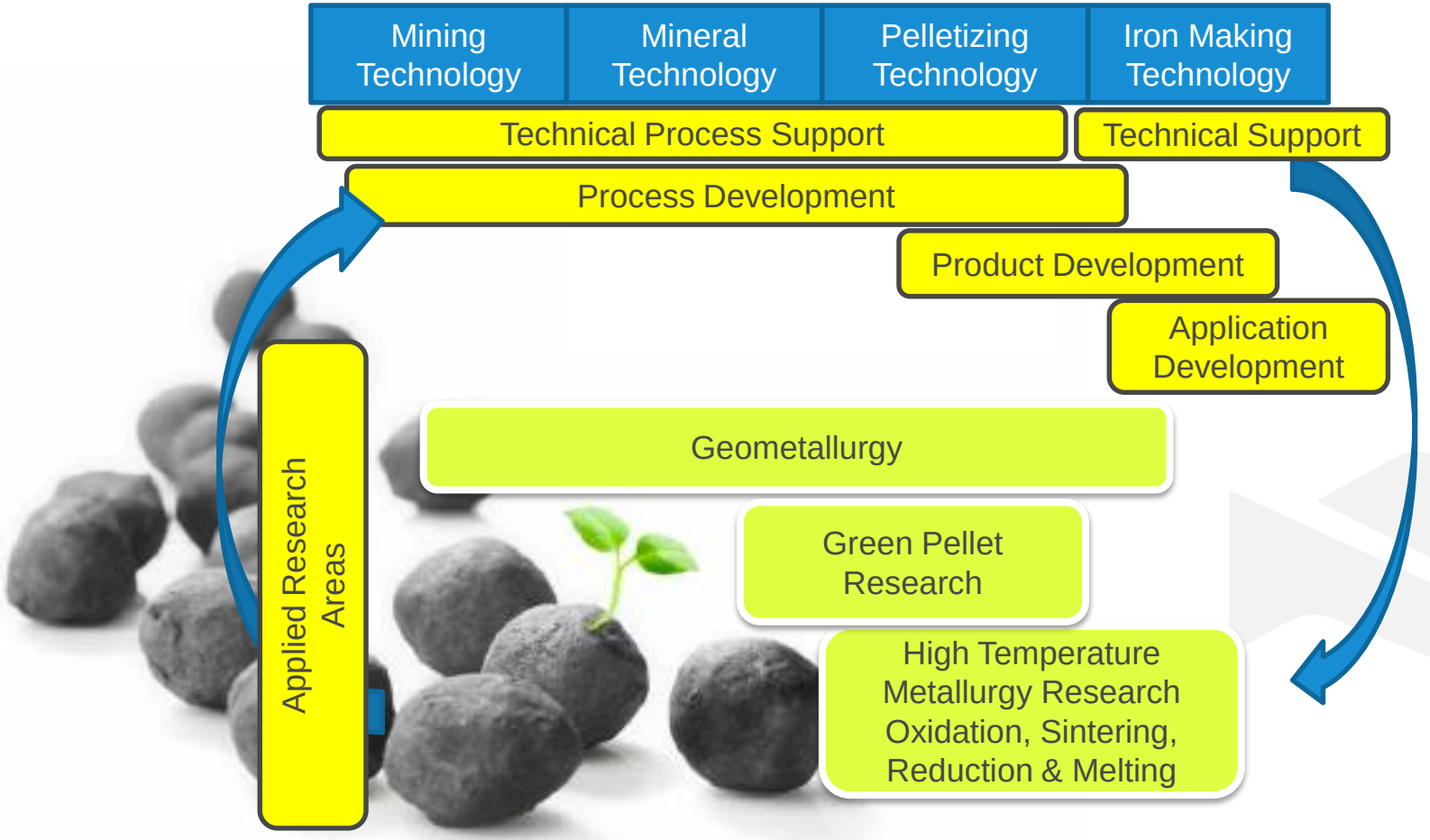
Mineral Processing Technology

Pelletizing Technology

Iron Making Technology

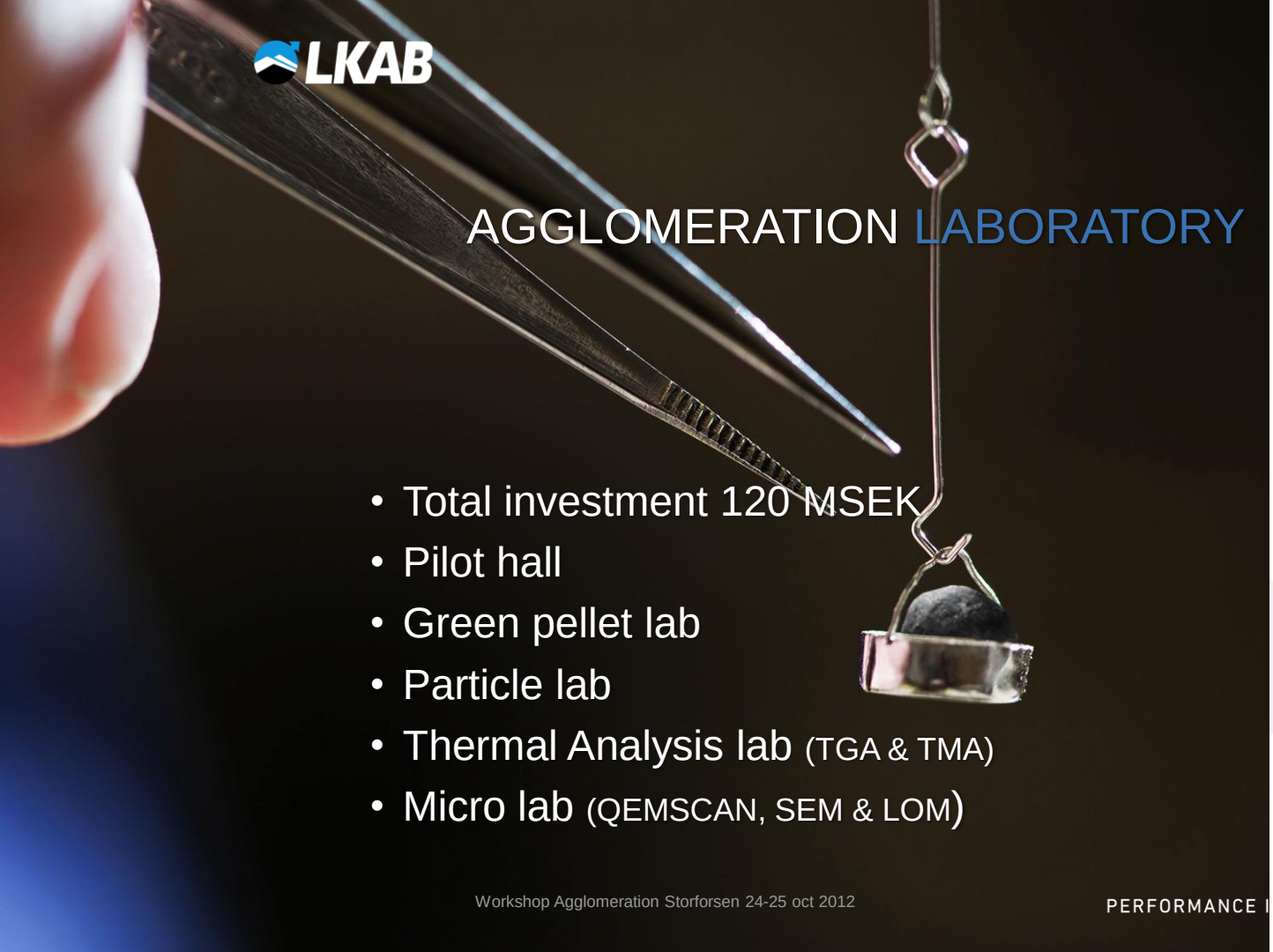
- **100 people in R&D (LKAB 4200)**
  15 with PHD, 60 MSc / BSc,
  15 Technician, 10 lab worker
- **30 % Women (LKAB 14 %)**
- **Annual operational cost R&D 250 MSEK**

R&D CROSS FUNCTIONAL WORK AREAS



WHY ARE LKAB SO KEEN ON AGGLOMERATION?

- **Part of the product flow** ~90 % of the production is agglomerated, not just some small waste flow
- **Quality** - Green pellet quality → Final product quality !!
- **Capacity** – Optimal green pellets is one cornerstone for high and stabile production
- **Production Cost** – Energy(Fans, fuel etc)

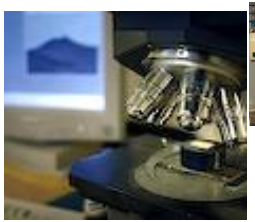


AGGLOMERATION LABORATORY

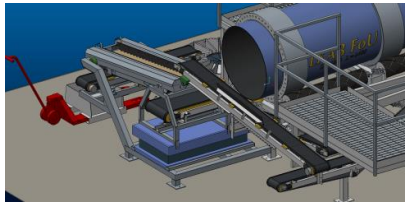
- Total investment 120 MSEK
- Pilot hall
- Green pellet lab
- Particle lab
- Thermal Analysis lab (TGA & TMA)
- Micro lab (QEMSCAN, SEM & LOM)

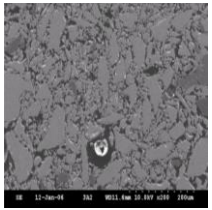
Toolbox for R&D Pelletizing

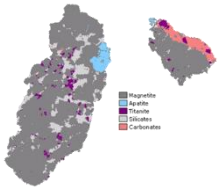
Micro scale | Lab scale | Pilot scale | Full scale



Pilot balling unit

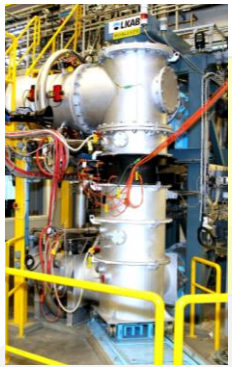




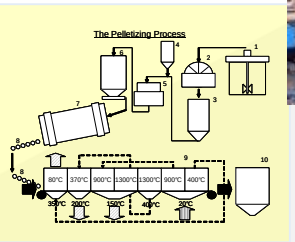


TGA/TMA

Pot furnace



EPP



PELLET PROPERTIES

Balling

Drying

Oxidation

Sintering

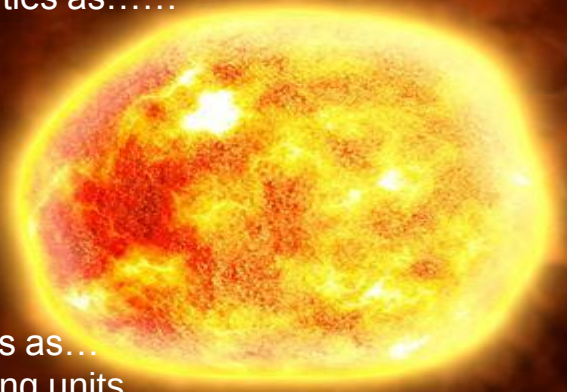
Final Pellets

Green Pellets with properties as……

- Size Distribution
- Strength
- Plasticity
- Porosity
- Pore Size Distribution
- Cracks

….and dynamic properties as…

- Productivity in the balling units
- Amount of over and under size green pellets



All this will effect both the process and the final product……

POTENTIAL IN GREEN PELLETS

Strength
Size
Form

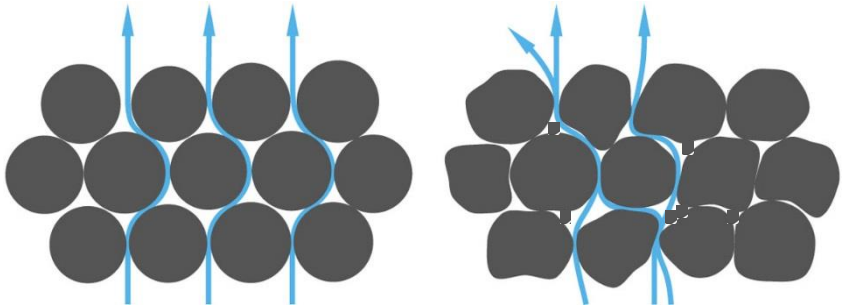
Oil consumption / capacity
- Production cost
- Productivity

Dust, Fines
- Production lossses
- Environment

Pellet quality
- Uniform quality
- Competitiveness

High quality green pellet is a prerequisite for good final pellet quality and an energy efficient production.

HOW DOES A GOOD GREEN PELLET LOOK LIKE?



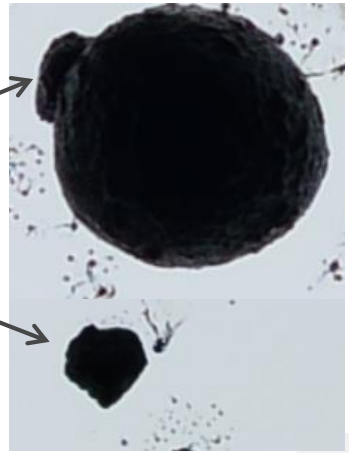
An ideal pellet bed.

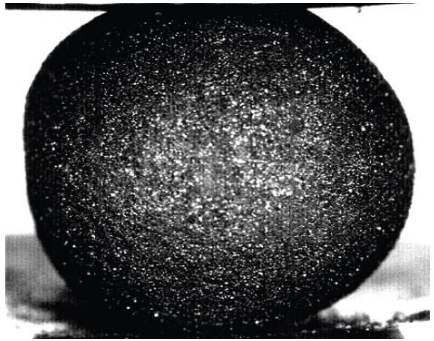
Pellet that cause problem

Strength: Strong enough, no disintegration during handling and feed into to the induration machine.
Size: Narrow size distribution.
Form: As round as possible

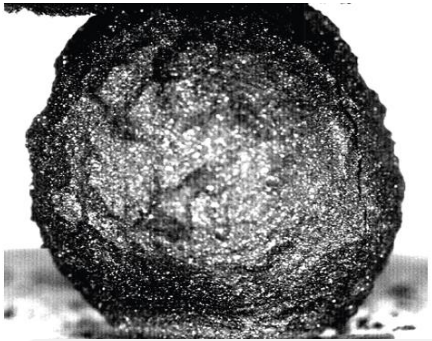
TYPES OF GREEN PELLET

Form
Roundness, riders, fines





Perfect green pellet

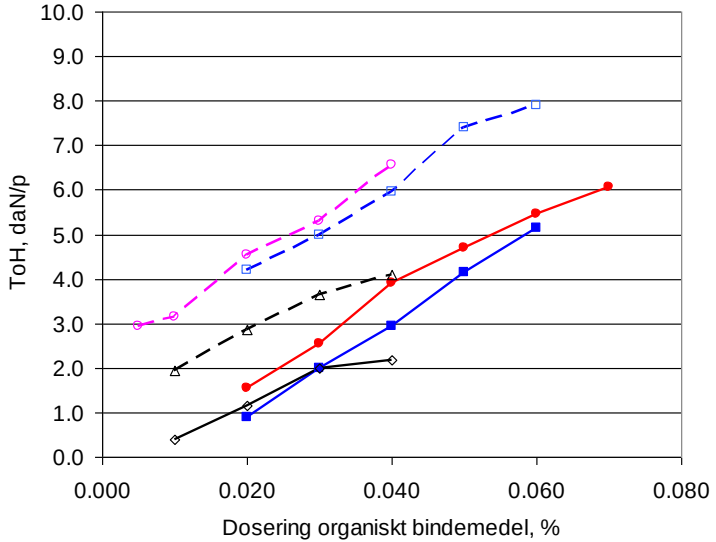


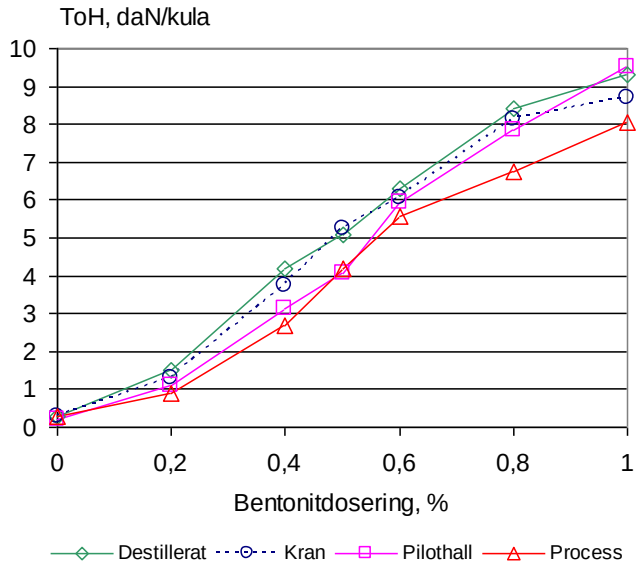
Uggly green pellet

WHAT TO START WITH?

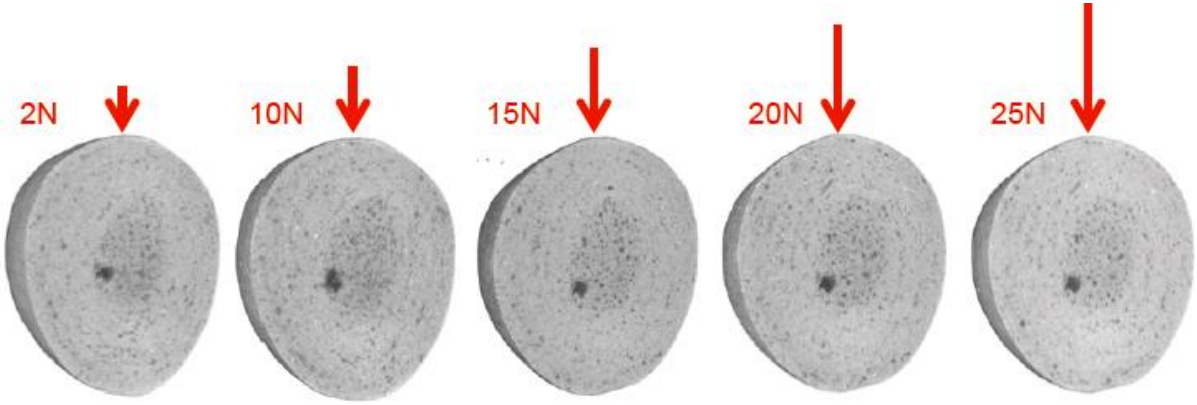
Size	Form Roundness, riders, fines	Strength
• Active control to reach target value • Optimal size of screen rollers • Control speed of screen rollers	• Control moisture in concentrate • Control moisture in green pellet • Minimize fines in to the indusration	• Mixers • Amount of bentonite

ISO standard - not enough

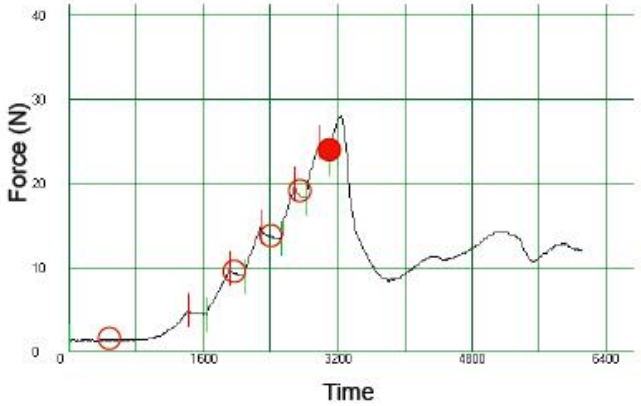




X-ray tomography



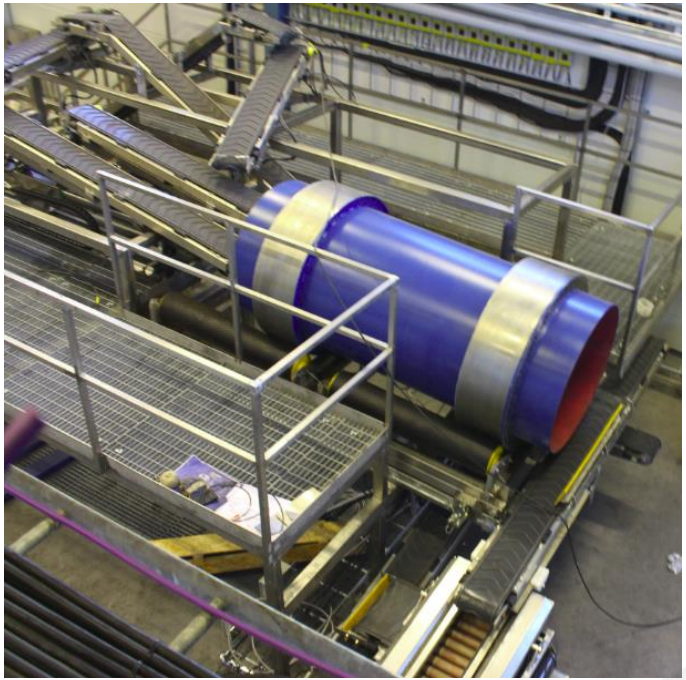
New state-of-the-art X-ray microtomography system (Zeiss Xradia 510 Versa), installed in Luleå Feb 2016.

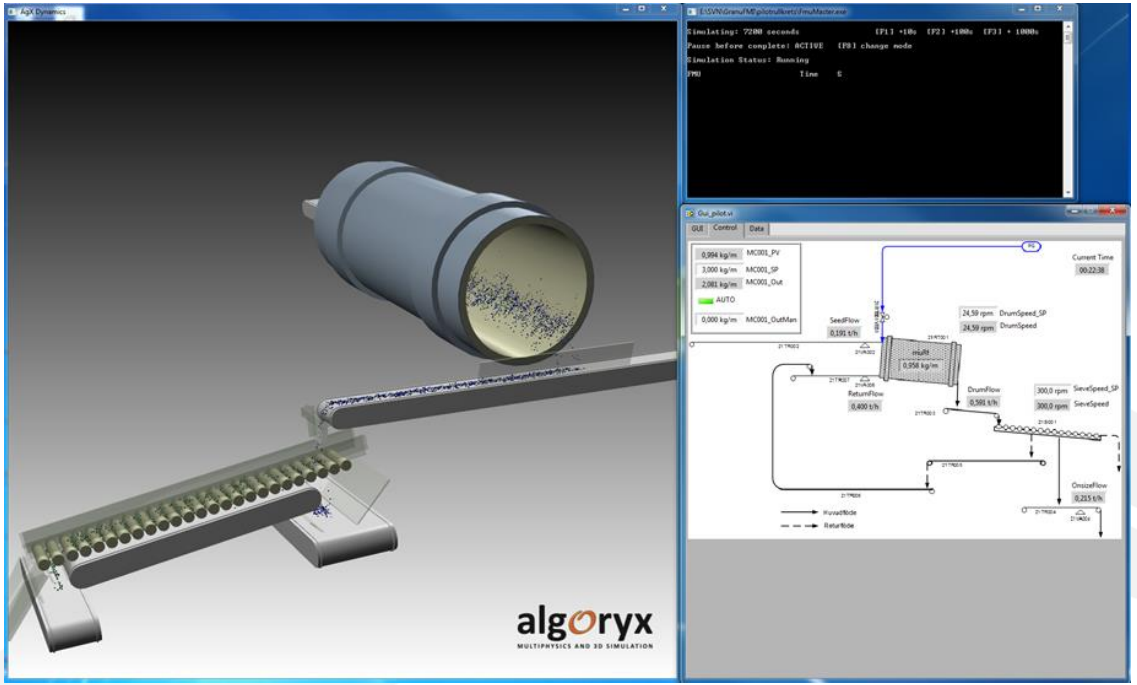


Particle modelling

Experimental studies

Modelling & simulation





Thank you for listening

Questions?