



# Where is Filtration heading in Mining ? Concentrate & Tailings Filtration

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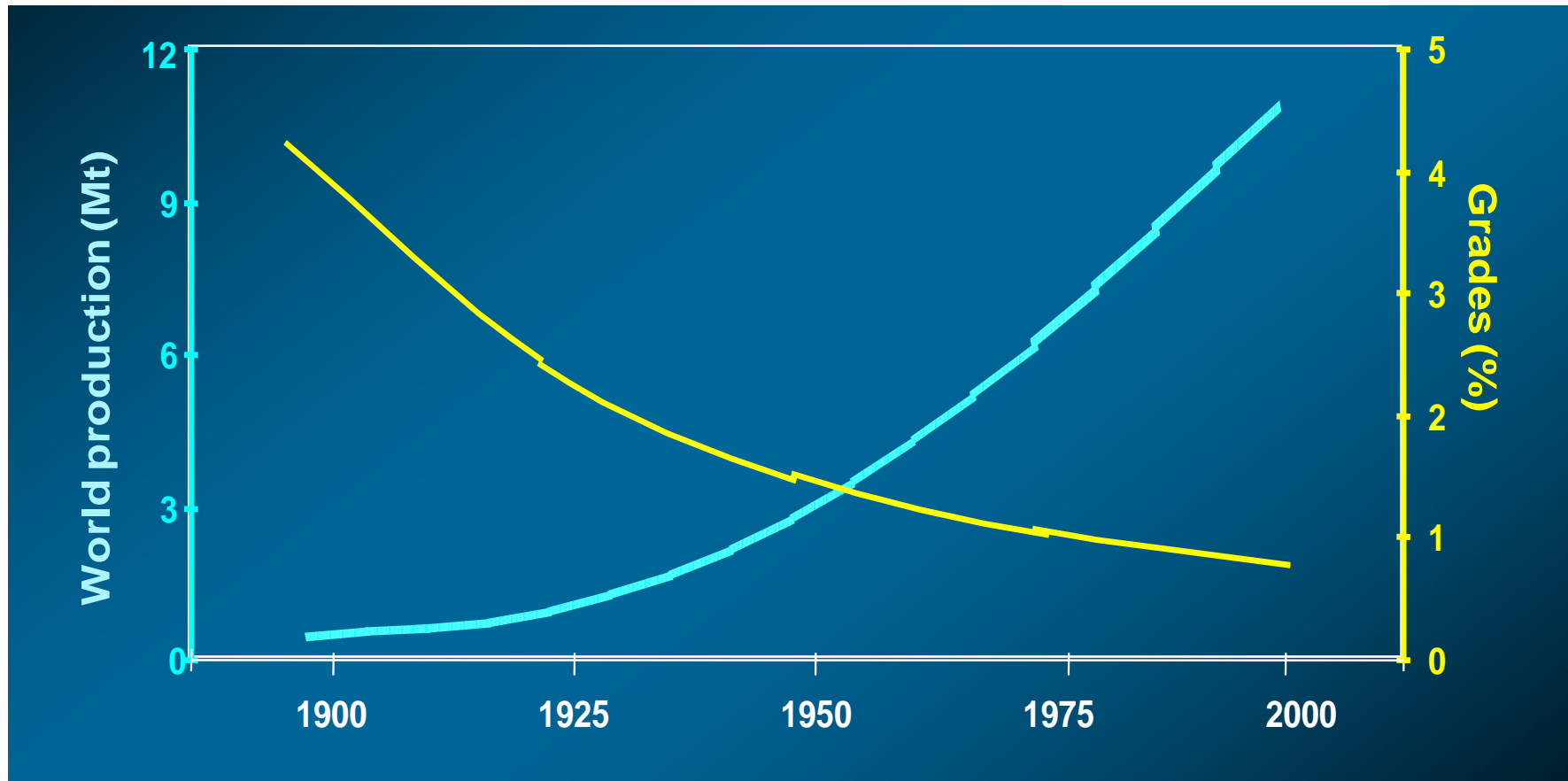
**Outotec**  
More out of ore

# Where is the Mining Industry going?

- Mining tonnes are increasing.
- Grades are decreasing.
- Mines are getting deeper
- Mines are getting wetter as they get below the water table.
- Commonly now we see typical tonnages for Iron ore in 10Million tpa modules



# Declining grades



Copper production  
BHP / Codelco

# Mineral Processing Trends

Grinding finer to achieve mineral liberation

Mineral as a fraction of the resource is steadily declining as the easy resources are exhausted and more difficult ones are found

Flotation is now commonly used to achieve separation of minerals from the waste rock.

1970,s	p80	100um
2000	p80	30um
2010 +	p80	20um or less

Economies of scale are steadily increasing the tonnes of mineral being mined and with lower grades

1970,s	10 mta
2000,s	50 mta

Effect on concentrate filtration

1970,s	Vacuum filtration
2000,s	Pressure filtration

Water recovery from tailings

1970,s	discharge to tailings pond through water open circuit
2000,s	Thickening and water recycle from the tailings pond
	Partial recycle (Paste Thickening)

Dry stack tailings





# Mineral Processing Trends

- 10 years ago Haematite was being mined – crushed and screened and shipped as DSO and contained  
66 – 68 % Fe
- Some of the tailings contain  
45 – 58% Fe
- Mines now have to wash and dry their Ore so process are more complicated.
- These mines are also now looking to beneficiate their tailings and to make better uses of their resource.
- Creating complex process flows in which filtration becoming critical. Filter size and number of units and control of moisture levels in concentrate.



# Market Drivers influencing Product development

1. Water scarcity is causing limits to processing capability
  - High water costs
  - Implications of recycle of process water
  - Advantages in mine closure
2. Scale of economy
  - Current filtration technologies barely suitable
    - Bigger units, less units, moving components, operators, maintenance
      - Operational cost €/tn
      - Total investment cost – NPV
    - Improvements in maintainability and media cleaning are required
3. Simple is strongly preferred by mining companies
  - CCD circuits predominate in solute recovery circuits
  - Paste thickening seem the preferred technology for water recovery
  - Filtration need to boost credibility and reliability if it is to be a serious contender for tails treatment
  - Longer media lifetimes demand improved clean-ability options to be developed

# What has this meant to Equipment

Milling technology has improved substantially

- The capacity of mills has increased substantially
- Fine grinding has become a reality with significant reductions in achievable particle size

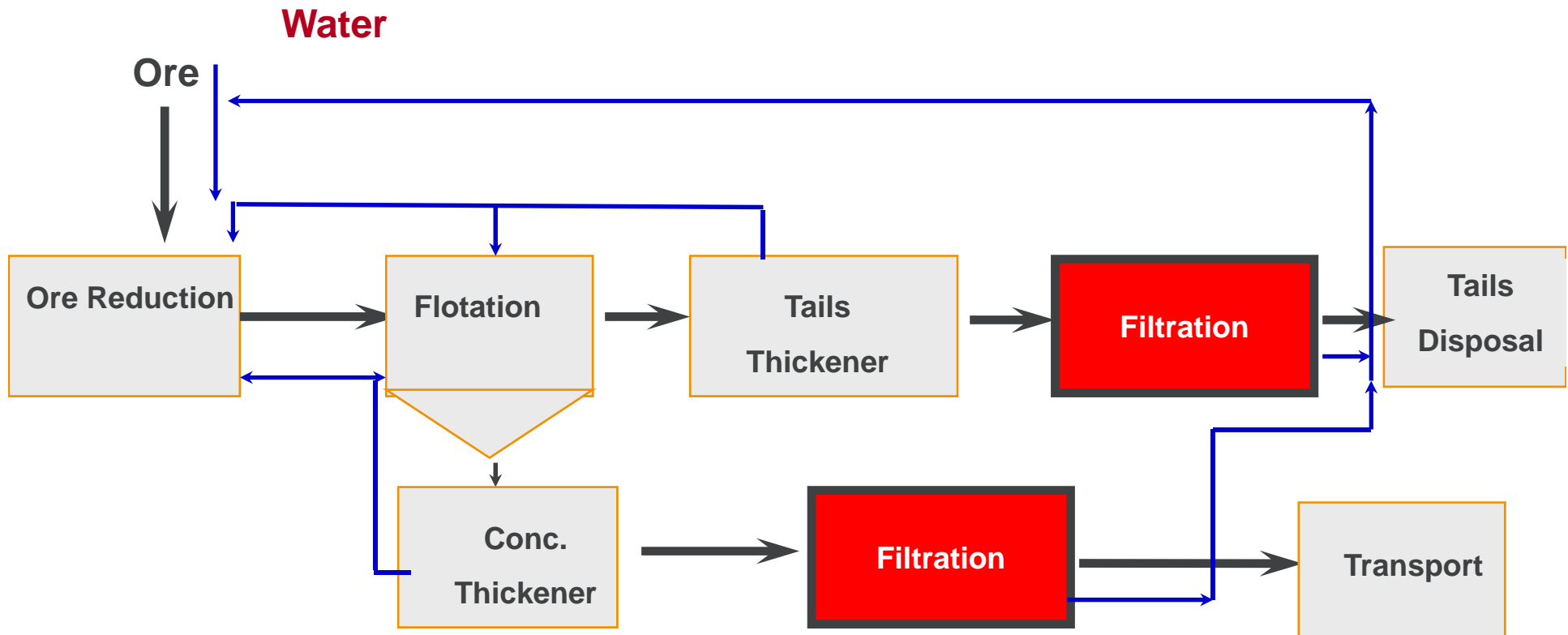
Scale of economy advantage

- Customers are looking for bigger unit operation
- Bigger units, less units,
- Remote operators,
- Maintenance programs

**Filter development has not necessarily increased at the same rate.**



# Where are Filters in the process - Concentrators





# Filtration Requirements

Tower filter presses satisfy the requirements of product filtration but they have been too small for tailings filtration

Example

50 mt/a

5800 t/h Plant

Filtration rate of 380kg/m<sup>2</sup> requires 15,000 m<sup>2</sup> or more to filter the tailings

Most of today's tower filter technology is too small (90 units or more of the largest units 168m<sup>2</sup>/ unit)

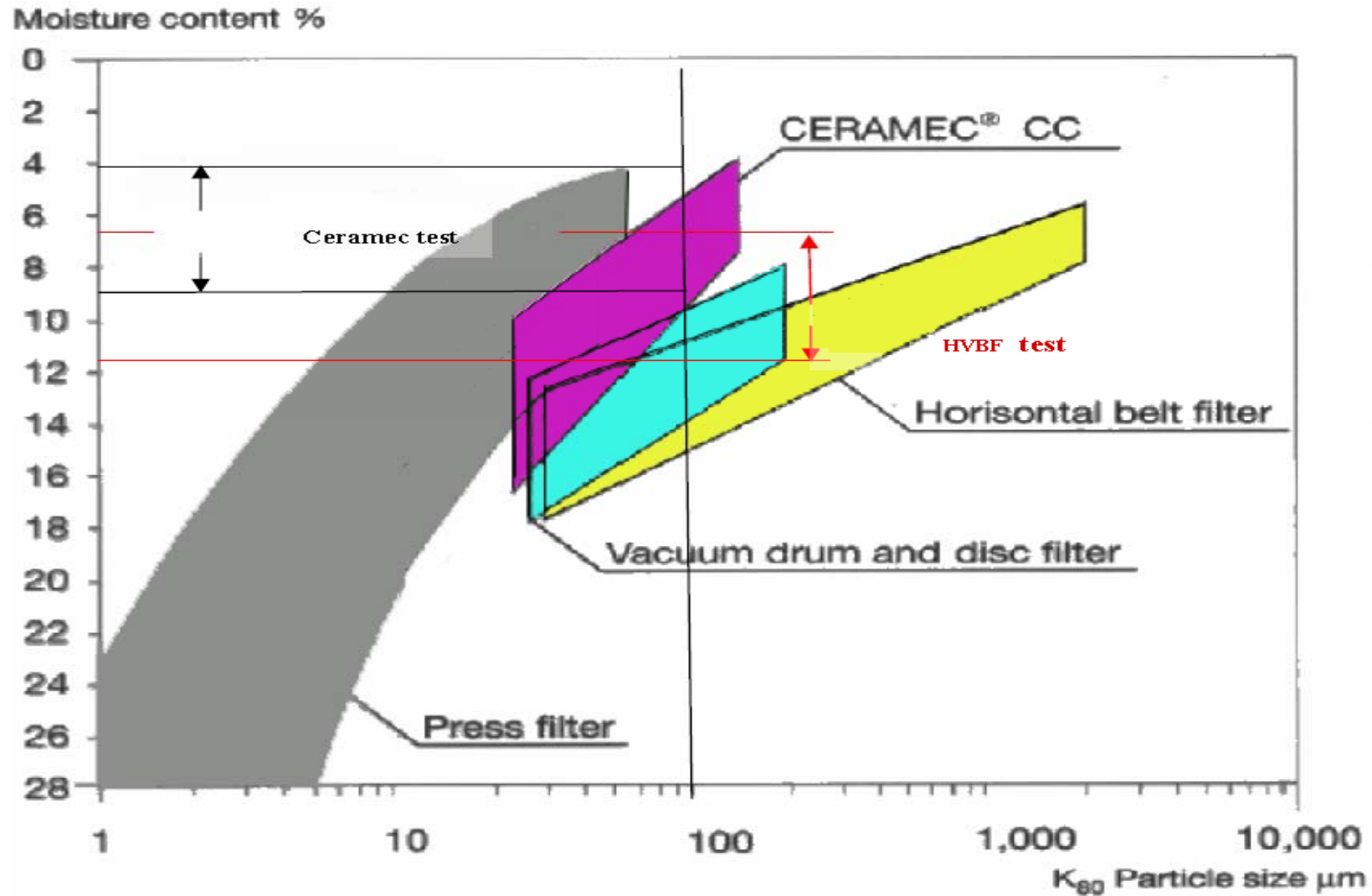
Horizontal Pressure Filters with larger m<sup>2</sup> available are reaching design limits due to length of filters.



# Filtration Equipment Milestone Changes

- Vacuum Disc filters have been available with 150m<sup>2</sup> to 200m<sup>2</sup> for decades
- Horizontal belt filters have been available with 150m<sup>2</sup> to 200m<sup>2</sup> for decades
- Conventional pressure filters have doubled in area in the past decade
- Ceramec filters have increased 5 times in area in the past decade
- Tower presses have increased 8 times in area in the past decade

# What Filter fits where?



# Outotec Filtration Technologies

## Horizontal Vacuum Belt Filters



## Vacuum Drum & Disc Filters



## Vacuum Filtration

- Simple
- Reliable
- High Energy demand
- Practice Limits of Technology
- Performance is limited by atmospheric pressure

P80 50um

P20 25um

Max Unit size is around 200m<sup>2</sup>

Few companies have invested in the technology recently.



# Pressure filtration technology

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# Outotec Filtration Technologies



## Tower Filter Presses

- Pressure Filtration
- Complex
- Batch operation
- Performance limited by plate size and pumping velocities
- **2010** Plate size 1.5 x 4m 6m<sup>2</sup>  
75mm chambers  
Max Unit size to about 168m<sup>2</sup>
- **2011** Plate Size 1.5 x 6m 9m<sup>2</sup>  
75mm chambers  
Max Unit size to about 240m<sup>2</sup>
- Practical limits of technology  
Companies have invested in the development of the technology recently.

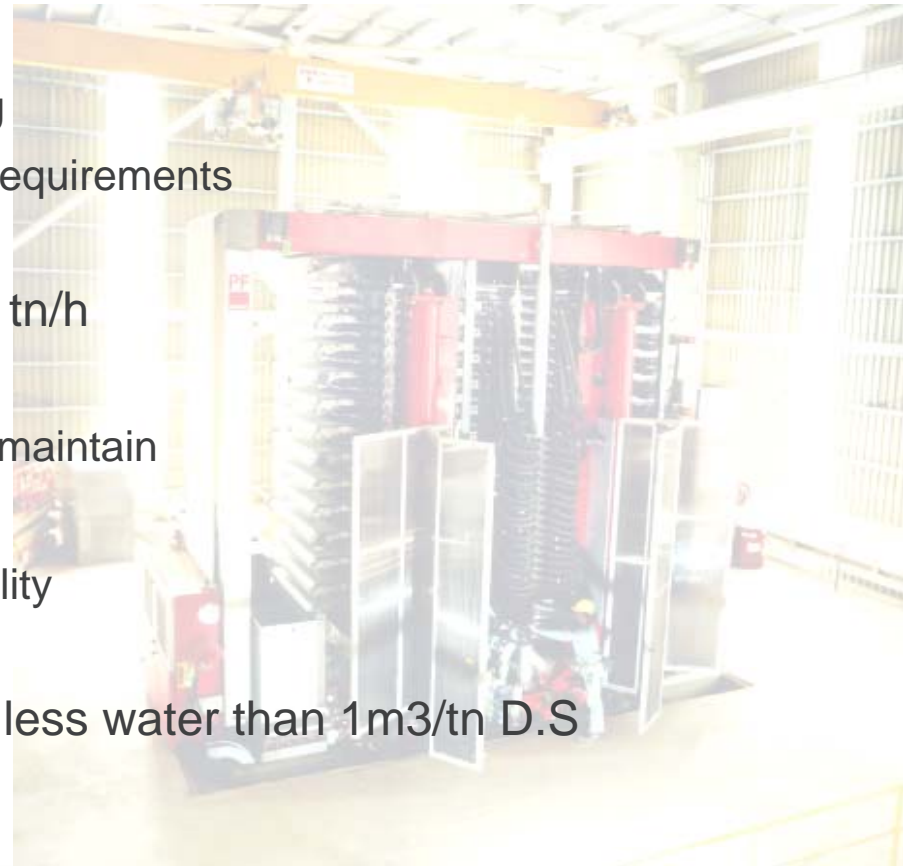
# 180 Series Tower Press

## 240m<sup>2</sup> Tower press



# Outotec PF Filters

- Dry Filter Cake - even below 4% moisture
  - Even with fine solids or “difficult” slurries
  - Reduced transport costs
  - Reduced or eliminated thermal drying
  - Improved materials handling and blending
  - Reduced area for dry stacking – no dam requirements
- High Unit Capacity - even more than 150 tn/h
  - Fewer units to operate and maintain
  - Large filter plates – fewer components to maintain
  - Smaller footprint and filter building
  - Turn-up, turn down and expansion capability
- Efficient Filter Cake Washing - even with less water than 1m<sup>3</sup>/tn D.S
  - Low wash liquor consumption
  - High solute recovery with clear solute



# Outotec PF Filters

- Automatic Operation – 24/7 un-manned operation, designed availability > 98%
  - Guaranteed cake discharge
  - Reduced manpower requirements
  - Process control for consistent performance
  - Data logging and remote monitoring
- Filter Cloth Management – lifetimes even up to one year
  - Efficient cloth washing
  - Consistent cloth performance
  - Reduced “blinding”
  - Extended cloth life
  - Wide choice of cloths to optimise filtrate clarity, cake release etc.



# Capillary Action Disc Filters



# CERAMEC FILTERS



Continuous operation

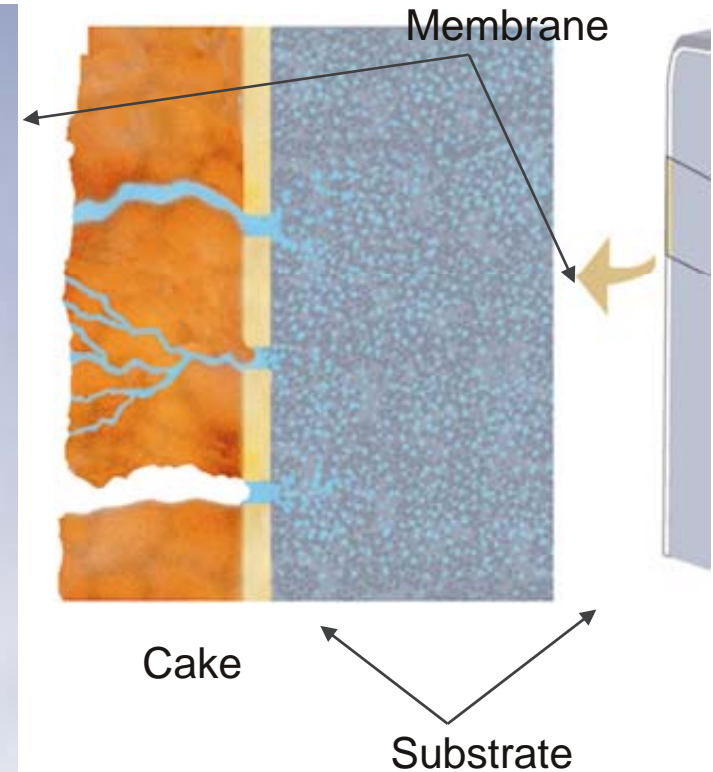
Capillary action Filtration

Performance limited by  
feed density

Low total installed klw

Larges Filter (144m<sup>2</sup>) only  
uses 5.5klw vacuum pump

# Capillary filtration - Influence of Pores



Filtrate "blocks"  
the capillars  
⇒ No air flow through them



# CC Technology in Iron Ore

- Fine iron concentrate production capacity has increased by more than 50%
- Grind size has decreased putting more emphasis on filtration requirements
- CC technology has substantially reduced energy, labour and infrastructure requirements.
- CC technology has increased the range Ceramec plates
- PSD with p80 of 25um or finer for the same product moisture



# Ceramec Plate Changes

Continuous effort takes place in development of filter element and cleaning procedures.

This is done in close co-operation with Universities and suppliers.

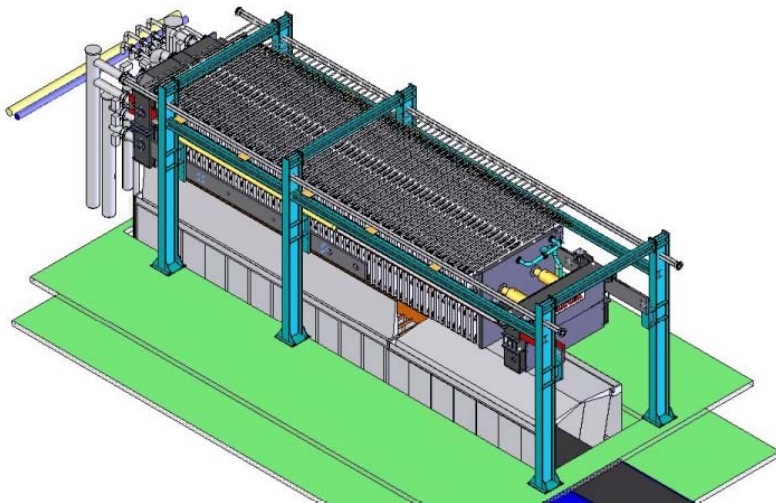
For the past decade only Grey and blue plates were available.

Now we have available red – blue – green – grey – orange for different applications.

# Outotec Filtration Technologies



Horizontal Filters



- Pressure Filtration
- Complex
- Batch operation
- Performance limited by plate size and pumping velocities
- Plate size 600 x600mm to 1.5m x 1.5m
- Unit size 200m<sup>2</sup> to 600m<sup>2</sup>
- **2009** 2.0m x 2.0m
- Unit size to about 600m<sup>2</sup> to 1000m<sup>2</sup>
- **2010** 3.0m x 3.0m
- Unit size about 600m<sup>2</sup>
- Practical limits of technology and companies have invested in the technology recently for product filtration.

# Rectangular Plate packs



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# Fast opening Filter Presses FFP 2512



# Tailings Filtration



## Key Features for new FFP product line

- Filtration areas up to 572 m<sup>2</sup> and up to 17m<sup>3</sup> volume
- Semi-continuous, quick-batch
- For medium density slurries, dry cake discharge PSD<sub>80</sub> ~40 micron
- typical feed, thickener underflow,
- clear filtrate allows suitability to recover cyanide



# Back to our Gold Tailings example

Example

50 mt/a

5800 t/h Plant

Filtration rate of 380kg/m<sup>2</sup> requires 15,000 m<sup>2</sup> or more to filter the tailings

FFP Horizontal Pressure Filters FFP 2512 60/60 (576m<sup>2</sup>)

- We still require 34 units



# Cloth Life

- Cloth life Cycle
- 3000 – 5000 cycles
- Filter Cycle time
- 9 Minutes – 133 cycles per day
- Cloth replacement every 22 – 37 days
- Cloth Changes per year 16 – 9

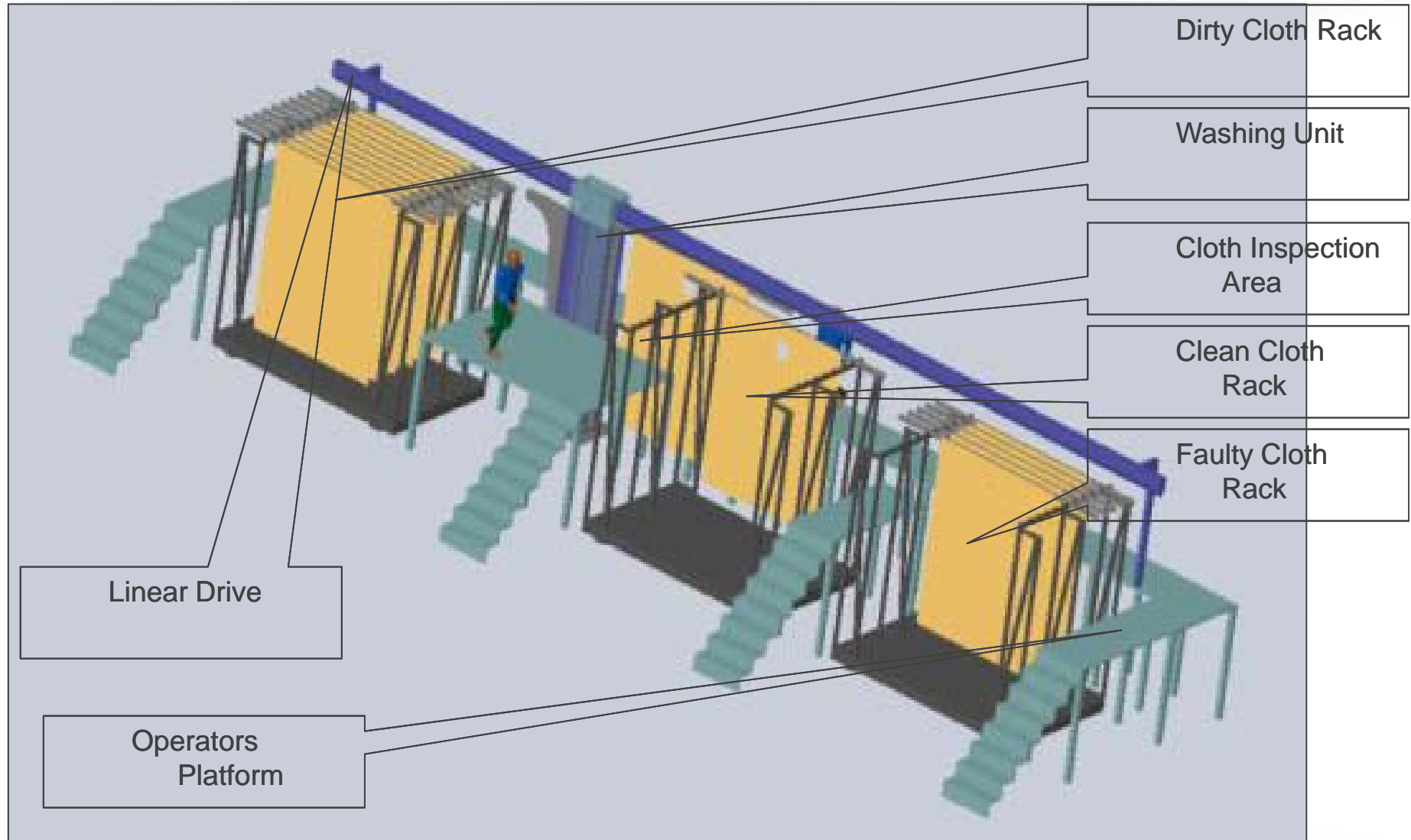
assuming 20 hour days 365 days per year 7300 hours



# FFP Facts for 5 Filter Installation

- 60 Chambers = 120 Filter cloths x 5 = 600 filter cloths
- Time to change each cloth 15 – 30 minutes
- 150 – 300 hours
- Estimated Annual usage
- Every month 7 - 15 Days (20 hour day) changing filter cloths.
- 5400 to 9600 cloths per year.

# Cloth Wash Station

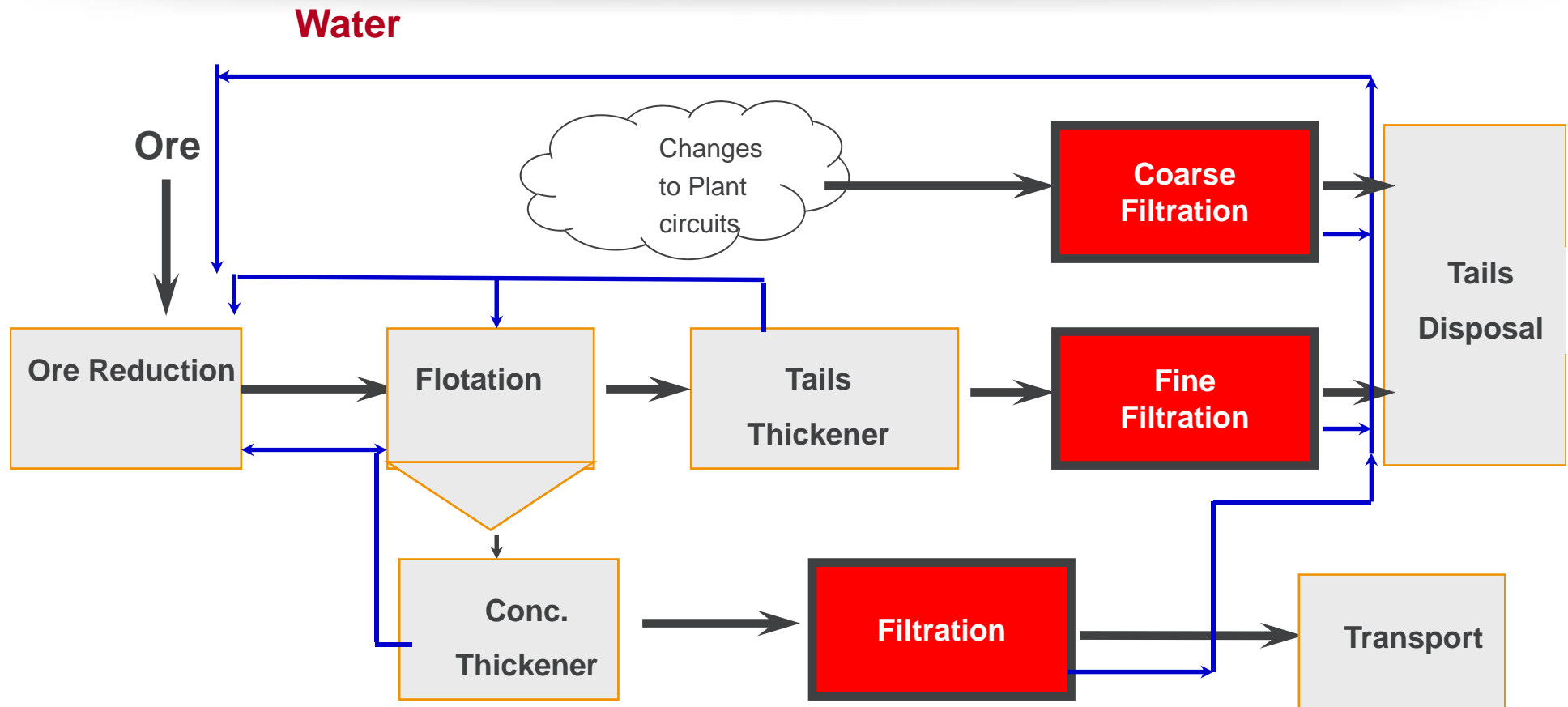




# Investigation

- Cloth Disposal options  
9000 / annum cloths to land file?
- Can we recycle?
- Manufacture filter cloths from Bio degradable material?
- Back to the beginning? Re look at the process.

# Change the process design





# Thank You

**For further information contact your local Outotec office**

[www.outotec.com](http://www.outotec.com)

**or**

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