

WTS AB

POWDER BURNERS

Conversion of 120t/h steam boiler (CHP)
from coal to a biomass fired

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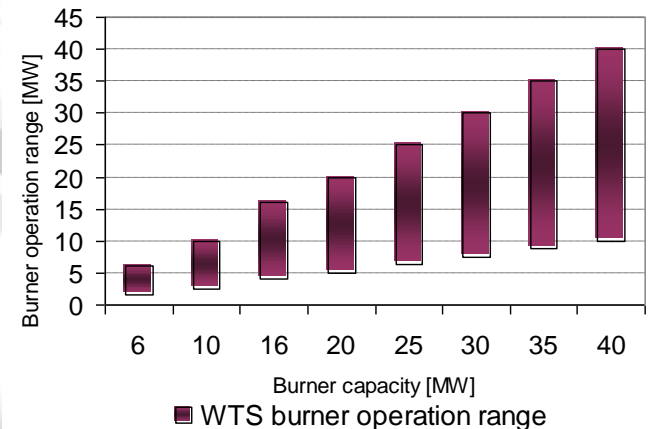
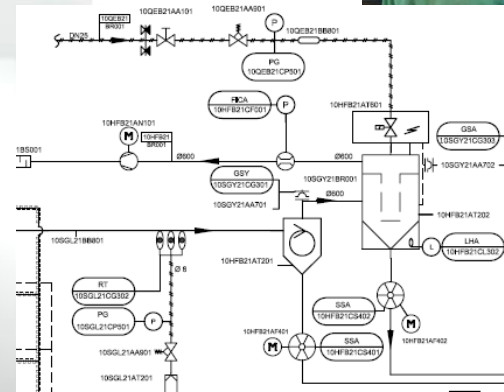


Presentation structure

- ✓ Introduction company profile,
- ✓ Conversion of 120t/h steam boiler (CHP) from coal to a biomass fired,
- ✓ Main assumptions of conversion came from Request for Quotation – RFQ

World Thermal Service AB company profile

- ✓ Production: WTS has own product it is biomass powder burner. The burners are designed for two or three fuels: biomass powder, gas (natural or process), oil (light, heavy or process)
- ✓ Design: Biomass storage, pneumatic transport, milling and dosing units for combustion systems. Oil and gas trains for burner.
- ✓ Consulting: biomass installations, pellet production, evaluation of existing installation as third part, feasibility studies.



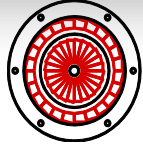


100% conversion of a 120 t/h steam boiler coal fired at CHP to biomass fuel

Project in numbers:

- ✓ Steam production for turbine: 120t/h with temperature 500°C at pressure 7,5MPa.
- ✓ Flue gas emission: NO_x and CO bellow contract limits,
- ✓ Biomass fuel: a wide range of combust biomass source, wood and mixture of wood biomass with agro biomass,
- ✓ System is design for pellets and micro chips biomass with wide range of density,
- ✓ Total weight of delivered machinery: 240 ton,





Milling house:

- 1/ Raw biomass silo with 300m³ volume including out-feed system,
- 2/ Building with four hammers mills. Nominal capacity 21t/h of powder. Powder 100% below 1mm and 70% below 0,5mm,
- 3/ Pneumatic transport with 4 powder separation units,
- 4/ Powder silo 200m³ with out-feed system,
- 5/ Two pneumatic transport systems, length 140m, altitude 15m, capacity 2x15t/h.

Boiler house:

- 1/ The 8 Burners fuel: natural gas / biomass powder, maximum capacity 16,5MW per burner. Total thermal load 100MW at 6 burners in operation,
- 2/ Biomass dosing systems to burner, natural gas pressure reduction stations and 8 burner gas lines with safety valves and instrumentation.





Request for quotation – RFQ issue by Investor base on:

- ✓ Feasibility study carried out by the Investor,
- ✓ Regulations for biomass combustion systems apply in the country where project was made.

Additional point:

- ✓ Experience and knowledge provided by contractors, e.g. burners and milling system supplier WTS AB

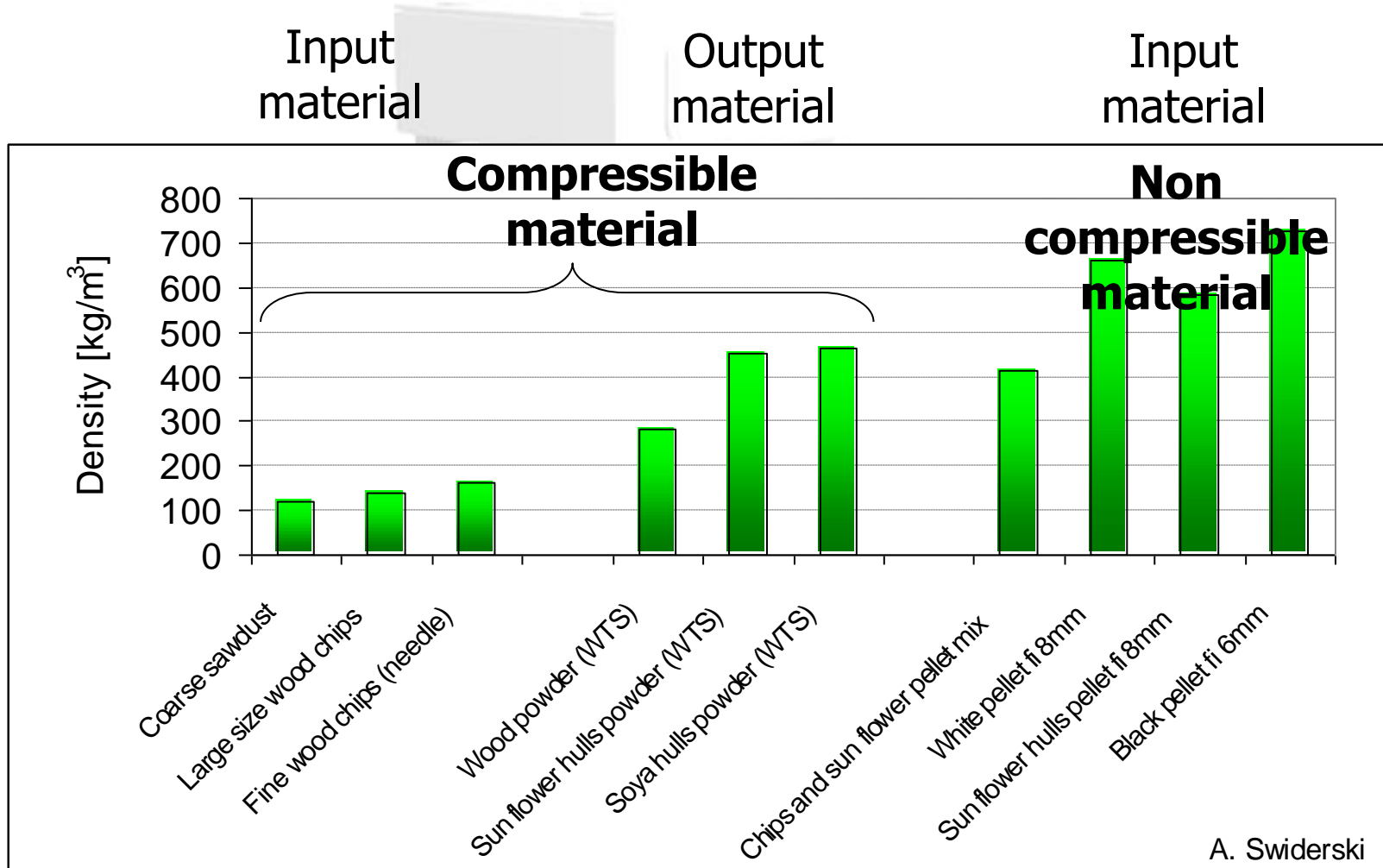


Main Investor assumptions

1. Boiler part:
 - ✓ The coal powder boiler was converted to biomass powder combustion system with dedicated milling system,
 - ✓ Combustion system have 8 burners. The 6 burners in operation and 2 in stand by,
 - ✓ Boiler steam production will be reduce from 140t/h to 120t/h (15% reduction),
2. Use fuel:
 - ✓ Input biomass to milling system will have different shape (pellet, chips), with bulk density from 120 to 650kg/m³ (80% variation),
 - ✓ Biomass LHV as receive in range 16,5-18,0MJ/kg (10% variation), average of all use fuels,
 - ✓ Biomass moisture content 6-10%,
 - ✓ Up to 45% of agro and 55% forest biomass,
 - ✓ Agro biomass: sun flowers pellets, straw shred, willow chips,
 - ✓ Ash content up to 5%,
 - ✓ Nitrogen content 0,6%,



Biomass properties, density



Density depends on material type and shape.



Biomass type and structure

- ✓ Pellet from white wood, sun flower hulls. The diameter 6-8mm, length 3-4xd
- ✓ Chips from willow, wood residues with bark.
- ✓ Shredded straw

Chips, 100% agro



Powder, 60% agro
40% forest biomass



Pellets 60% wood fi12mm,
40% agro fi6mm



~60% Chips 40% pellets
fi6mm (wood+agro)



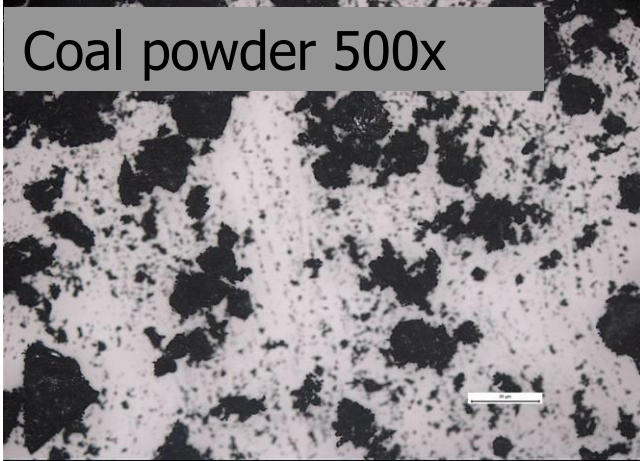
Powder, 100% white wood
(pellets)





Biomass properties, powder particle structure

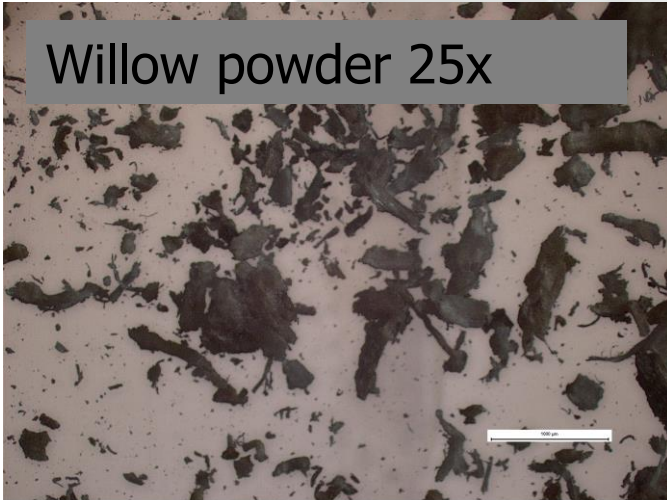
Coal powder 500x



Wood powder 25x



Willow powder 25x



Straw powder 25x

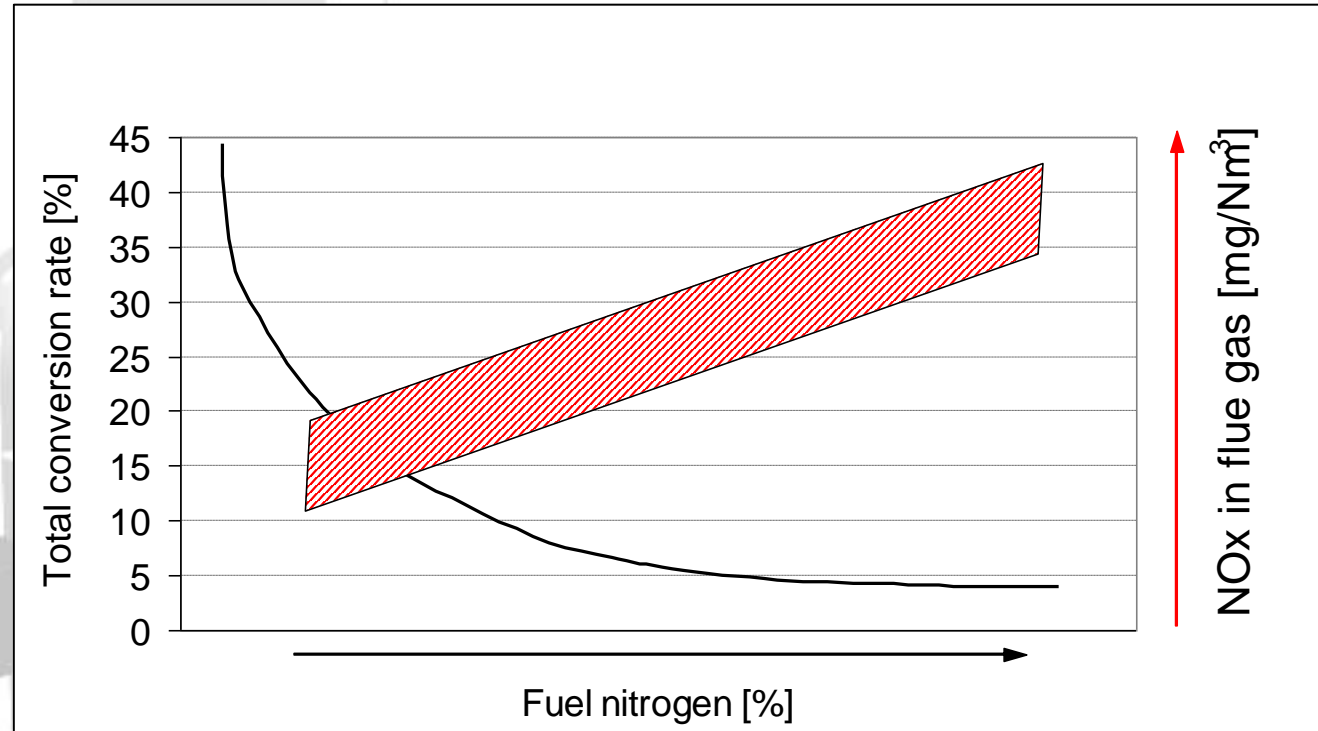




Biomass properties, nitrogen

Fuel nitrogen conversion to nitrogen oxide (NO_x) tendency

Biomass	Fuel nitrogen [%]
Sunflower husk pellet	0,9
Sunflower husk pellet	3,27
Sunflower husk pellet	1,81
Wood pellet	0,42
Wood pellet	0,18
Straw rols	1,01



Conclusion:

- ✓ Investment cost in nitrogen oxide reduction system can be reduce by selection fuel with low nitrogen content.

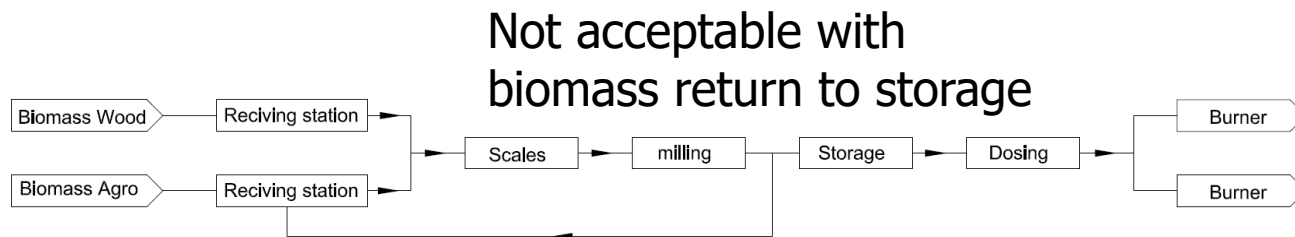
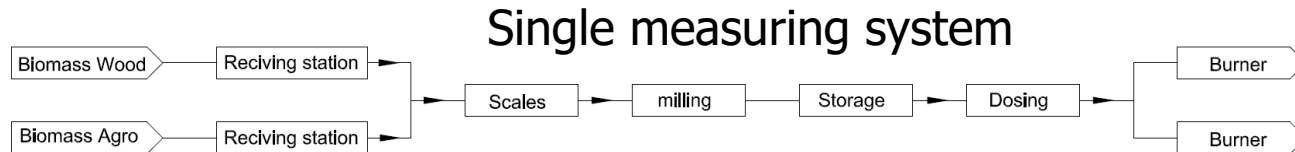
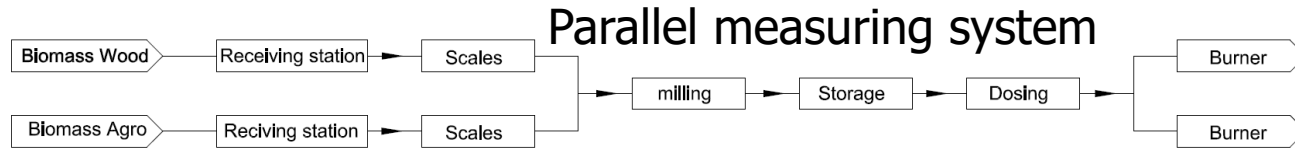


Local regulations for biomass combustion systems

- ✓ Only biomass fuel can be fire during electricity production, generator is synchronized:
 - 1/ The natural gas was used only during boiler heat up process with minimum amount,
 - 2/ Only direct ignition sequence for burner start up at nominal boiler operation can be use. During direct ignition sequence biomass is ignited by near flame,
- ✓ Two type of biomass agro and wood have to be combust together. Each mass flow need to be measure by certificated scale. After weight measurement biomass transport system is close.
- ✓ Emissions limits in flue gas for NO_x, CO, Dust



Weight measuring system



- ✓ The biomass mass flow to the boiler have to be measure online by certificated scale,
- ✓ Each type of biomass mass flow have to be measure and show to authority,
- ✓ Biomass can not be return to the storage silo after pass weight measuring system.



Experience and knowledge provided by contractors

- ✓ Boiler pressure part modification for new burners size. Selection of burner location at the boiler,
- ✓ Modification of burners wind box size for installation between two pillars supporting the boiler,
- ✓ Separation of the fuel preparation and storage system from the boiler room area,
- ✓ Supplying pneumatic transport system resistance to erosion caused by high ash content in fuel,
- ✓ Supplying conveyers for wide range of biomass density and shape (pellets, chips),
- ✓ Supplying protection and suppressing system for wide range of K_{st} [m bar/s] and P_{max} [bar] parameters



Burners and related systems at boiler

- ✓ The 8 burners are located at two levels,
- ✓ Burners: turn down ratio 1:5, burner load 3,3-16,5MW 20-100% can be reach on biomass and natural gas fuel, combustion air temperature up to 330°C,
- ✓ Direct biomass ignition sequence during steam production,
- ✓ Flue gas recirculation for steam temperature trimming,
- ✓ Water gun for evaporator wall cleaning,
- ✓ OFA and SOFA system for stage combustion,



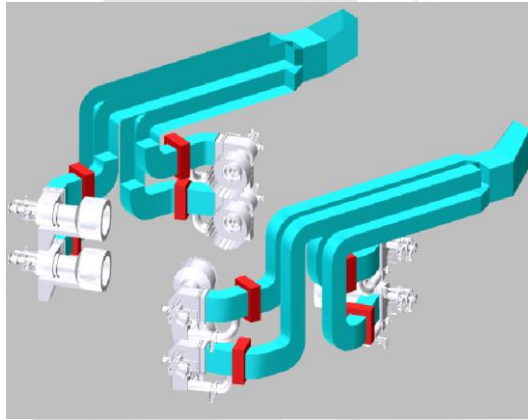


Combustion system replacement to biomass powder burners

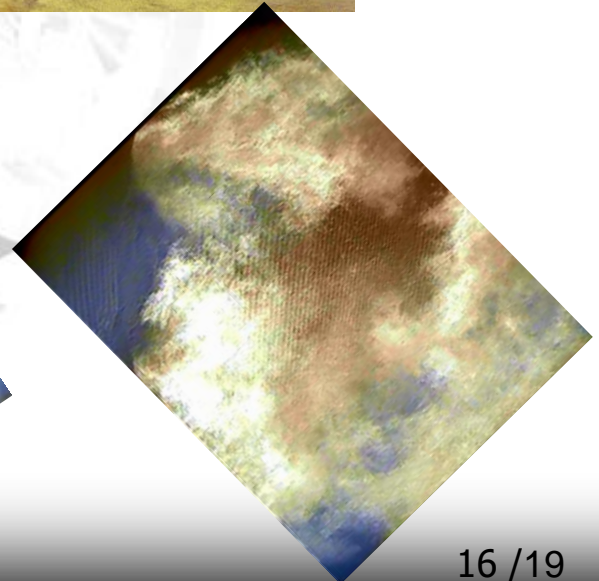
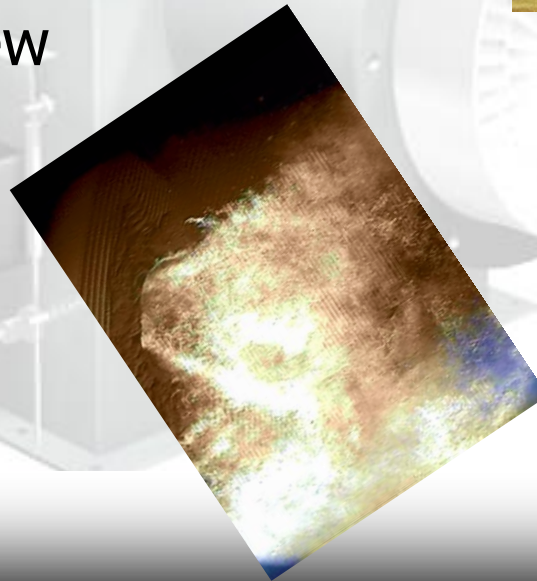
Old coal powder firing burners



Dual fuel biomass burners located at boiler corners



WTS burners flame view





Biomass dosing system with 8 burners and natural gas trains

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graph TD; A[Powder preparation] --- B[Powder silo]; A --- C[Raw biomass silo]; B --- D["V=200m³"]; C --- E["V=300m³"]
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Powder preparation

Powder silo

$V=200\text{m}^3$

Raw biomass silo

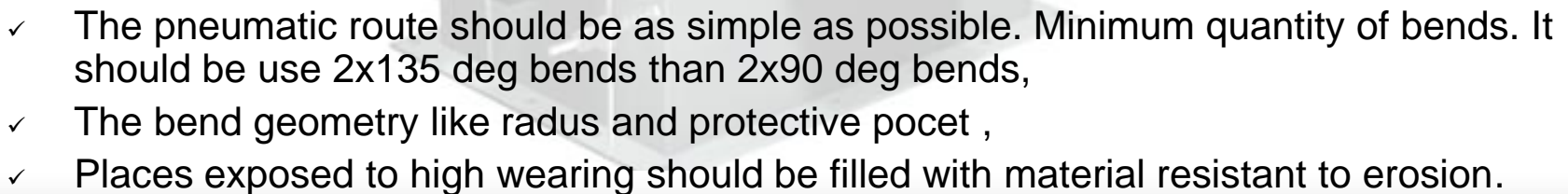
$V=300\text{m}^3$

4 mills house



Pellet
receiving
station

Chips
dryer





Biomass properties, explosion

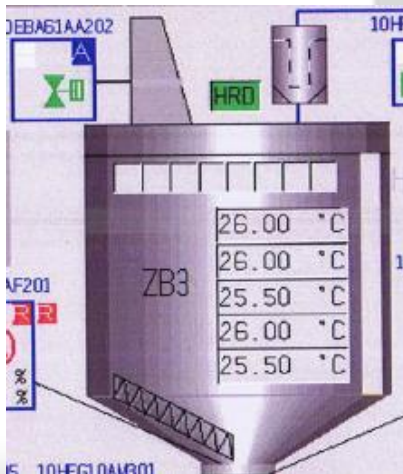
Biomass parameters:

- ✓ Index of maximum rate of pressure rise K_{st} [m·bar/s]. For wide range of biomass is in range $K_{st}=9-161$ m·bar/s. Maximum explosion pressure for biomass is in range $P_{max}=5,9-8,4$ bar
- ✓ The biomass types should be identify and assume at design project stage. Wider range of used biomass types increase costs of protection systems.

Preventing systems:

- Spark and glowing particles detection system,
- Electronic nose, multi gas component detectors in silos,
- Multi point temperature detectors in silos

Temperature sensors
in silos



Glowing particles detectors and water injection nozzles at silo inlet





Systems

Protection systems:

- Passive - explosion panels, Q-box
- Active - suspension systems

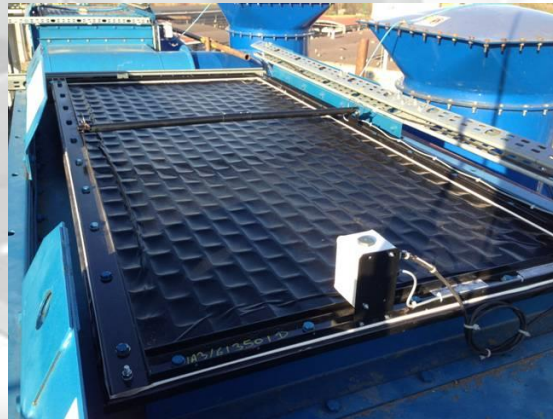
Suspension system installed at machinery and inlet pipe. Indoor location



No equal explosion panels location on silo wall



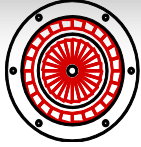
Top explosion panel location on filter and cyclone



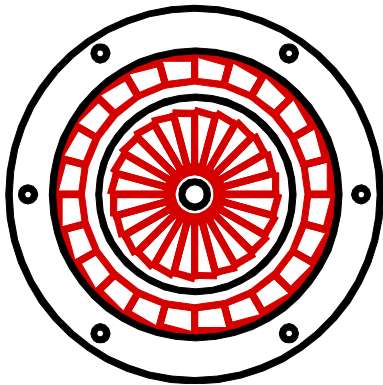
Q-box, explosion panel with flame quenching cover



WTS



Thank you!



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