



Modern Pet Coke Storage Systems

ready for future environmental demands, efficient & flexible blending operation

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INTRODUCTION

The Eurosilos® system is well suited for storing all available grades of petroleum coke, both green coke and calcined coke at anode plants. Eurosilos® systems are in operation for coal at power stations and at industrial boilers in a growing number of places.

The realization of enclosed storage systems solves important environmental issues. Environmental requirements worldwide are met by the Eurosilos® storage system.

Economics and operational benefits however, are usually the main drivers to choose for the Eurosilos® system. Significant cost savings in operation, such as utilizing dynamic blending, cuts back the pay back period.



Fig. 1: Multiple Eurosilos® system

HOW DOES IT WORK?

FILLING

Filling takes place in the silo centre over a belt conveyor housed in the roof gallery. The coke is conveyed through the inlet hopper down to the equalizing augers by a centrally mounted telescopic chute and a dust lock at the outlet of the chute. The silo filling is accomplished by the equalizing augers on the auger frame which is suspended by steel wires from the slewing bridge.

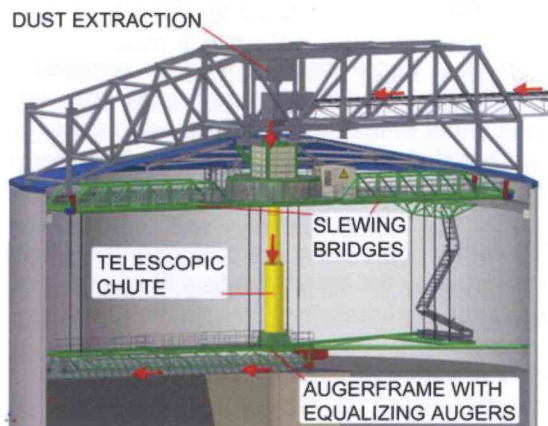


Fig. 1: Inside view of the Eurosilos® system

The auger frame can be lifted or lowered by a winch system, thus following the surface of the bulk solid. The equalizing augers convey the coke outwards to the wall, whilst a simultaneous stepwise slewing of the auger frame takes care of filling the silo in evenly spread layers.

RECLAIMING

Reclaiming of the silo is initiated by two weigh feeders, arranged centrally at the silo bottom. They feed the coke onto a belt conveyor, which can convey the coke of several silos simultaneously. The out flowing coke causes a central core flow zone in the silo. The augers are now rotating in the reverse direction and convey the coke to the central flow zone filling the originated crater.

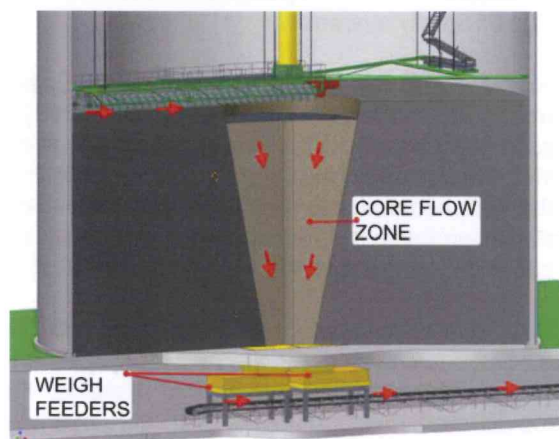


Fig. 2: Reclaiming of a coke silo



DUST AND FIRE PROTECTION

Reduction of the danger potential has been achieved by designing, on the one hand, a dust suppressing extraction and on the other hand an extensive air tight enclosure of the silo contents.

The dust suppressing infeed is reached by keeping an under-pressure inside the entire inlet chute of the silo. The telescopic chute and the housing of the dust lock are vacuumed by an ATEX protected dust extraction installation.

The entry of the air at the bottom of the silo is restricted by the weigh feeders filled with material. Penetration of air into the coke is limited to the upper surface. The oxygen concentration in the coke at the surface is clearly under 21%. Gas emissions of the stored coke if any, displace the oxygen.

Due to the natural ventilation, no hazardous / noxious CO, CH₄ gases or oxygen deficiency above the coke surface can evolve.

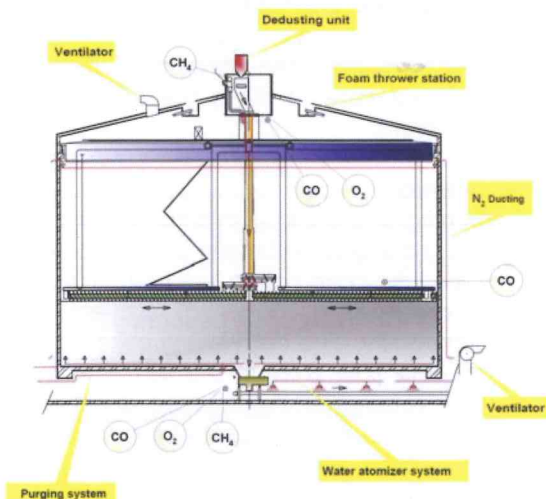


Fig. 3: Safety system

At the auger frame close to the coke surface and in the roof area, as well as in the conveyor gallery CO and CH₄ detection sensors are installed for early gas detection. To assure that the gas concentrations will be kept below the explosion limits a ventilator is controlled by the gas monitoring system.

Hot spots caused by oxidation will be recognized in an early stage by the gas and surface temperature monitoring systems. On top of that the temperature of the incoming coke is monitored at the intake of the quay belt. When the coke temperature exceeds the temperature limit, the belt turns off automatically.

The safety measures described above have been approved by international safety regulations for storing coal.

Calcined coke is almost free of volatile material because of the heating under a reducing atmosphere pre-treatment. Therefore the safety measures for storing calcined coke can be less severe. For storing green coke however with substantial volatile material the safety measures are recommended.

FIRE EXTINGUISHING SYSTEM

In addition to preventive measures, fire hazards must be controlled in case of an emergency. Fire extinguish systems that must be installed according to and in cooperation with local fire brigades authorities, a Eurosilos[®] system has the following optional provisions:

- For fire fighting within the silo a tube network is installed in the silo bottom through which the silo contents can be purged with nitrogen from the silo bottom upwards. A test has shown that N₂ purging can reduce within 30 minutes the oxygen content one meter below the coal surface to less than 5%. On top of that the silo surface can be covered with a foam layer by two stationary foam throwers.
- The transfer points of the in- and out feed belts are equipped with water spraying systems,
- The outfeed belt inside the tunnel and the transfer area of the weigh feeders are additionally equipped with sprinklers.

COKE BLENDING

Silo unloading is accomplished by an ongoing conveyor underneath the silos. The conveyor is fed in each case by two weigh feeders centrally arranged at the silo bottom. This handling system creates a continuously adjustable blending ratio from the silos from 1:1 to 1:4.

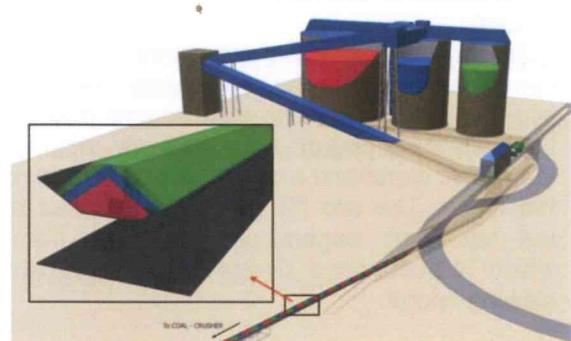


Fig. 4: Coke blending from a multiple silo system



Coke is reclaimed in layers by the "last in first out" principle. During coke unloading only the central core flow zone is in motion, whereas 90% of the silo content remains in a calm and compacted condition, avoiding loosening and separation. Additional homogenization of the coke is achieved by means of this loading/unloading procedure.

Already two silos will meet to a large extent the demands related to blending possibilities. The grades are divided in two parcels with similar quality criteria (e.g. high/low sulphur). The possibilities for creating blending ratios will improve more than proportionally if three or more silos are available.

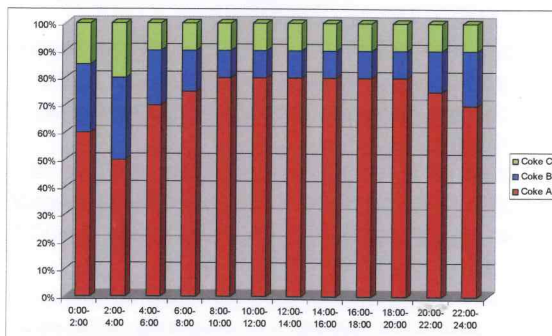


Fig. 5: Optimal blending depending on the demand from the anode production process

As power plant (or as anode plant-) availability requirements become more demanding, so does the demand for controlling the quality blend of delivered coke.

The ability to change the coke blending ratio is a condition, in order to fulfil the performance requirements. Very often the coke actual quality characteristics are only recognized during the process, because coke analyses are not available or are incomplete and/or do not apply. In these cases the damage can only be limited.

A demand related coke delivery schedule allows a blend of lower grade coke without negative effects on the operation and requires early and frequent information about the coke qualities – already in the purchasing of the coke phase.

Supported by coke management systems, cost optimized procurement concepts are possible.

SILO OPERATIONS

SILO FILLING:

The silo operation is fully automated; it is operated and monitored from the central control room. Personnel requirements exist only for the operation of the ship unloaders, the control room and for the inspection rounds. At the same time the control room is a switch point for materials handling activities and the respective administration.

The coke handling system is started up from the ship unloader, in case of malfunction signals the first analysis takes place in the control room.

These coke handling systems, including the silos, are regularly controlled by inspection rounds.

SILO RECLAIMING:

The filling of the bunkers from the coke silos is started by the shift personnel of main control room, after pre selection of the bunker and the blending ratio the filling procedure runs automatically.

RÉSUMÉ FROM AN END-USER

After eight years of operation of the Eurosilos® coal systems at the Tiefstack Power Plant in Hamburg, it has been confirmed by the plant operators, that:

- The operational safety and the handling availability of this advanced storage system is well proven.
- The conditions for the environmental protection are fulfilled
- The operational requirements of coal blending are fulfilled to a large extent!
- The maintenance expenditure compared with other coal storage systems is evaluated positively.

ECONOMICS OF EUROSILOS® STORAGE

The need of an accurate and up to date evaluation of the costs and savings of a new storage system is of greatest importance. The capital investments are only one part of such an evaluation. All costs over the total service life of the unit have to be considered.

The operating cost does not only include obvious factors like interest, energy consumption, maintenance, etc., but also the hidden costs, like product loss and quality loss by dust emission, self heating and also savings



by purposeful blending. These are indeed substantial cost savings, which should not be neglected over the total service life of the storage facility.

MAIN CRITERIA

Criteria to select a silo storage system are:

■ **Minimum space requirement:**

In the comparison with open storage area or flat storage, the specific storage capacity of a Eurosil® system is more than double, related to the required foot print.

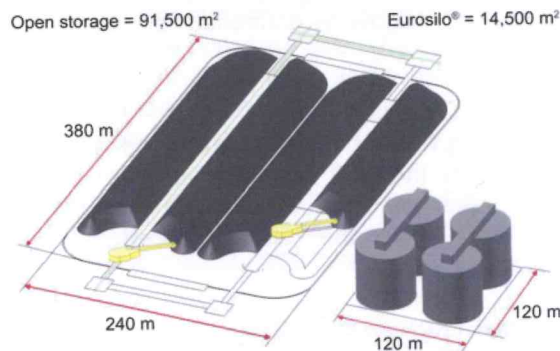


Fig. 6: Foot print of a 320,000 m³ coal storage

■ **No dust emissions:**

Additional measures to minimize dust emissions such as water spraying devices are not required. As a result dust emissions losses are prevented, which depending on the wind force, can amount to approx. 0.1 to 0.3 % of the annual throughput.

■ **No (ground) water pollution:**

Rain or spraying water does not come in contact with the coke stored in an enclosed Eurosil®. In areas with strong rainfalls (Monsoon) the water content of the coke can increase substantially with open storage, the coke may even flush away, which will decrease the heat value and quality of the coke. The water content of coke stored in a Eurosil® will even drop somewhat by evaporation.

■ **Minimum oxidation:**

The concrete (slip formed) Eurosil® ensures a minimum oxygen penetration into the stored coke. Oxidation cannot take place without oxygen!

In case of open coke storage the problem of self heating may occur, which may cause substantial quality losses! The hot spots are sometimes completely burned to ashes. This uncontrolled oxidation process also means an uncontrolled CO and CO₂ emission.

■ **Automation:**

The Eurosil® systems are completely remote controlled from the central control room. Since the silos are being filled and emptied systematically in layers, the position of the coke is well-known at any time.

Compared with other systems the Eurosil® system achieves the lowest operating cost.

FLEXIBLE PROCUREMENT

To procure coke cost-optimized at the market, an additional blending is frequently required, which will usually lead to a duplication of handling costs.

In case of a multiple-silo-system with variable discharge capacities it is possible to prepare coke on demand blends in variable blending ratios for a flexible operation.

The additional costs of blending operations have been omitted and even the coke blending ratio can be adjusted to the demand of the process. This means: "The right blends at the right time".

With a multiple-silo-system the blending ratio can, in comparison with the fixed blending ratio at the usual coke handling systems, be adjusted online depending on the actual process requirements.

COST SAVINGS WITH THE APPLICATION OF AN EUROSILO® SYSTEM

Storage capacity of an anode plant usually amounts to an average of 10% - 15% of its annual throughput, resulting in approx. 50,000 - 100,000 tons to be distributed over three or four silos.

Eurosil® storage systems pay for themselves by the resulting savings on annual coke consumption. Investing in Eurosil® storage systems for coke has a short pay back time.

For further information please contact us