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**Gericke**

## Low Wear Pneumatic Conveying of Fly Ash in a Cement Production Plant

GERICKE AG designed, manufactured, installed and commissioned a pneumatic dense phase conveying system to transport fly ash at the Maastricht cement production plant of ENCI, part of the Brussels based CBR Group.

The main goal of the system design was to minimize wear due to the abrasive nature of the product and thus reducing significantly the maintenance of the plant, while doubling the transport capacity utilising the existing air compressors.

### Plant Requirements

At ENCI cement plant fly ash is used as an additive to the cement. The fly ash arrives by barges and is transferred to two concrete storage silos of 1,000 t capacity each. Gericke were contracted to transport the product from the main storage silos to two 300 m<sup>3</sup> silos located above the cement mills. The scope of supply included project management, plant layout and detail design, supply of mechanical equipment and control, installation and commissioning.

The fly ash has a bulk density of 0.6 kg/litre with a particle size of 20 to 30 µm, is free flowing but abrasive.

The product is transported over a distance of 120 and 200 m, including a vertical lift of 30 m. The pipe routing is along an existing pipe bridge. The number of pipe bends could be minimized.

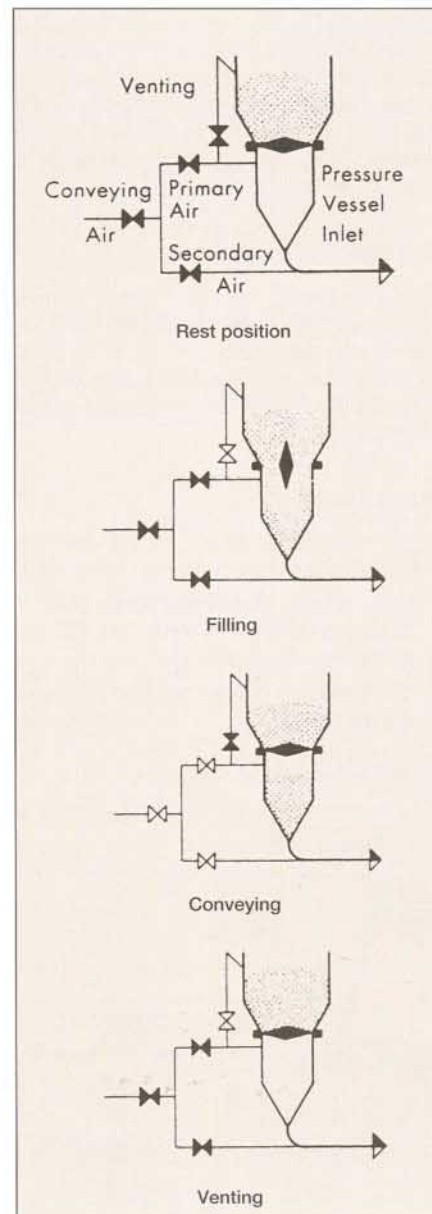
The main requirements of the plant were to maximize transport capacity with existing air compressors and to minimize wear of the equipment, as well as to ensure a dust tight operation to comply with health and safety regulations.

### Description of Dense Phase Conveying

With dense phase conveying much higher product concentrations in the conveying pipe are reached compared to lean phase conveying. This results in higher pressure drop. By means of a specially equipped pressure vessel and process control a highly loaded gas-solids flow is fed controlled into the conveying line. When only one pressure vessel is used to dispatch the product, it must be isolated from the supply silo before it is pressurised. This is a discontinuous process.

The operation of a single vessel dense phase conveyor is described in Fig. 1. At *rest position* all valves are closed. During *filling* the vessel inlet and vent valve are opened until the timer or level probe stops the filling process. At *conveying cycle* the conveying air valves open, the vessel is pressurised and the product dispatched to the conveying line. The end of the conveying cycle is signalled by manometer, low level probe or timer. The whole cycle finishes by *venting* and depressurising the vessel.

Fig. 1: Operation of dense phase conveyor



By using two pressure vessels placed in parallel it is possible to obtain continuous conveying. One vessel can always be in the conveying cycle whilst the other vessel is being filled.

### Description of the Fly Ash Conveying System

The fly ash is discharged from the two storage silos by means of fluidizing flow control gates with coarse and dribble feeding to the Gericke twin vessel dense phase conveyors type PHFD via special abrasion resistant inlet valves (Fig. 2). The two pressure vessels, one under each storage silo, comprise 5750 litres content each (Fig. 3). Via the outlet valves the product is discharged to the common conveying pipe of thick walled mild steel. At the end of the pipe the diameter is increased to ensure uniformly low product and air velocity.

Plant wear in a pneumatic conveying arises from impact and friction of particles to the wall, specially at the bends. In reality wear is proportional to the cube of product velocity. This means that the wear phenomena can be reduced by a factor of 8 when reducing the product velocity by 50%.

To minimize wear at the pipe bends special abrasion resistant elbows type GB are installed (Fig. 4). The specially constructed deflection chamber with a slowly rotating self renewing ball of product suspended in air deflects the main flow smoothly without destroying the uniform flow conditions, thus preventing wear of the bend and the adjacent pipe and resulting in low pressure loss.

A pneumatically operated high pressure plug diverter valve type TB installed into the pipeline directs the product into either of the two receiving silos (Fig. 5). A specially small diverting angle and an anti-wearing plug minimize wear problems.

The design of the dense phase conveying system was such that the existing compressor station with 3.5 bar supply pressure could be used. Pressure drop, pipe diameter, product and air velocities, size of conveying vessels and filters are derived from a special Gericke expert system. This system takes into account some important product data as well as plant characteristics. A large data base contains technical data of some thousand industrial installations and hundreds of trials at the supplier's test lab. The op-

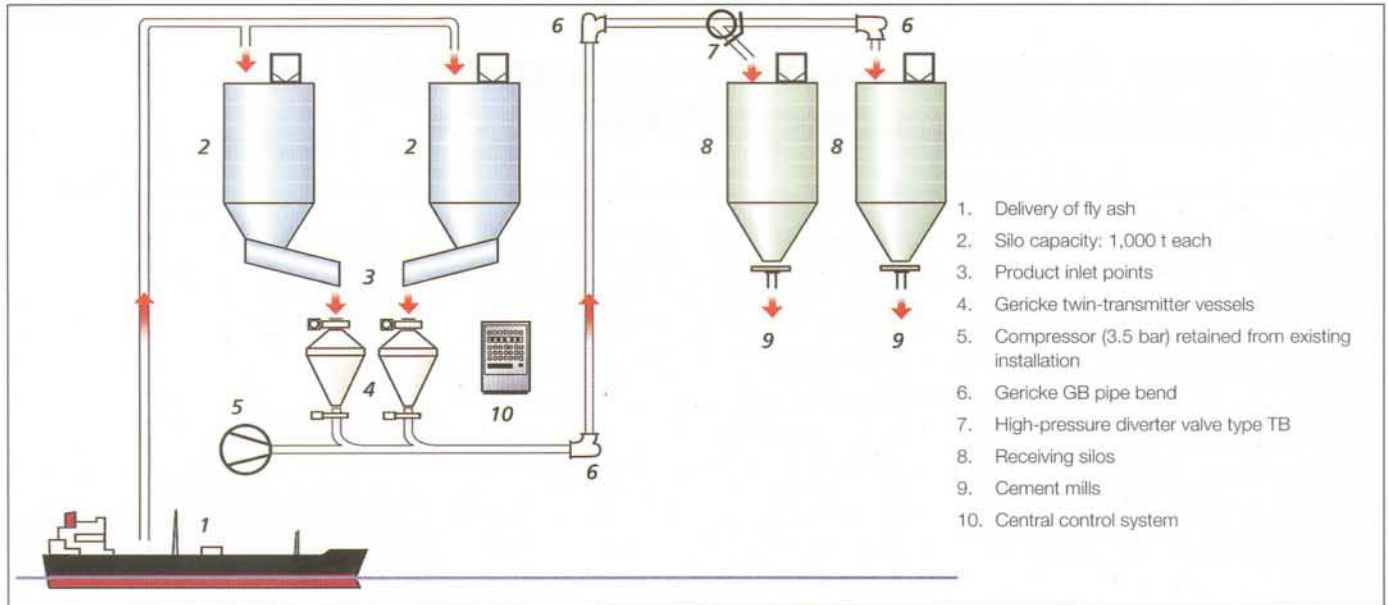


Fig. 2: Schematic diagram of fly ash dense phase conveying system at ENCI Cement Plant



Fig. 3: Gericke twin vessel dense phase conveyor PHFD 5750

timum solution between maximum possible conveying capacity and minimum wear had to be found.

### Operation

The twin vessel conveying system PHFD combines two batch operated vessels into a continuous conveyor. The vessel inlet valve opens to allow a flood feed of the fluidised product. After closing the inlet valve compressed air is brought into vessel and conveying pipe. The product is thus fed through the open outlet valve towards the receiving silo. While the first vessel is conveying the second is being filled in readiness for transfer, thus, supported by the special control system, a continuous material transport without interruption is created. Because no dead times limit the conveying capacity the twin vessel system is most economical for long conveying distances and large pipe diameters.

At operation of the twin vessel conveying system a capacity of over 80 t/h (approx. 133 m<sup>3</sup>/h) is reached. A great advantage of the installed system is that even with only one storage silo available it is still possible with single vessel operation to reach a capacity of 60 t/h.

### Experience

Owing to the high product to air loading factor the PHFD system reduced the specific air consumption by 40 to 50%. Thus by using the existing compressors the throughput of the conveying plant could be doubled.

### Advantages

- No rotating parts in contact with the abrasive product
- low velocity conveying and use of abrasion resistant bends type GB reduce wear to a minimum
- Maintenance costs could be reduced substantially.

Fig. 4: GB Abrasion resistant elbow

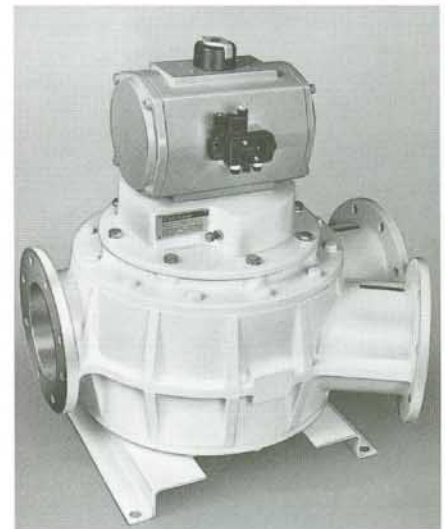
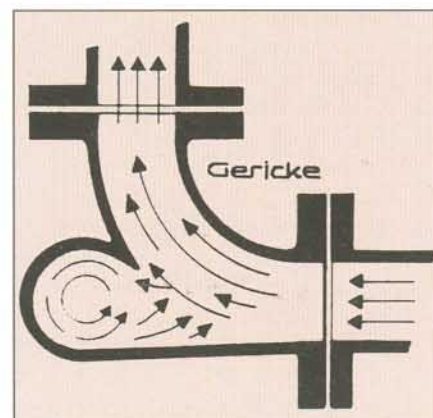


Fig. 5: TB Plug Diverter Valve

### Applications

The Gericke dense phase conveying systems are also applicable in the construction industry e.g. for cement, sand, gypsum, chaw, plaster. Final products as homogenous mixtures can be conveyed gently, with minimal segregation and with minimal product wear when using the Pulse Flow Conveying System PTA. Full scale trials can be arranged in special test houses or on the customer's premises.

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