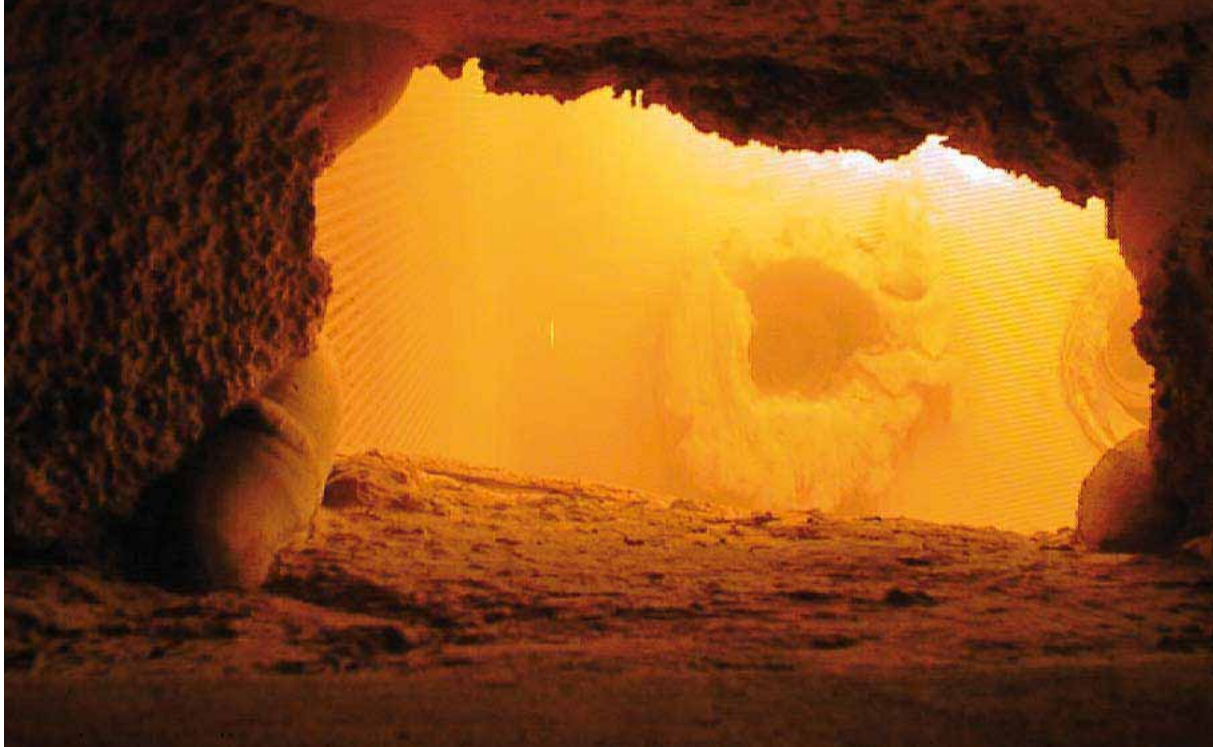




MATERIALS HANDLING SOLUTIONS

Our engineering know-how
makes all the difference





Supporting clean energy generation by bulk materials conveying and ash removal



A network of experience and knowledge

Clyde Bergemann Power Group (CBPG) offers a worldwide network of experience and knowledge and provides a comprehensive portfolio of systems and solutions for many applications.

Both, Clyde Bergemann Materials Handling and Clyde Bergemann EP Tech contribute to the ongoing development of systems and solutions supporting your quest for clean energy generation.

Global centre of competence for materials handling

Clyde Bergemann Materials Handling (CBD), headquartered in Doncaster/UK is CBPG's global centre of competence for materials handling solutions. CBD is responsible for ongoing research and development of environmentally friendly, innovative solutions including supreme products like DRYCON™ and Dome Valve proving committed development capabilities.

Our expertise in pneumatic conveying utilises both positive and negative pressure dense and lean phase conveying techniques. Additionally our hydraulic conveying capability incorporating both Lean-Phase and High Concentration Slurry Discharge (HCSD) systems enhances our technology range.

Our service is characterised by an emphasis on delivery, a proactive attitude, excellent communication skills, robust planning and management processes, professionalism, and customer focus.

Centre of competence for mechanical bulk materials handling

Clyde Bergemann EP Tech (CBEPT) is CBPG's Italian subsidiary and the centre of competence for mechanical bulk material handling, specialising in supplying solutions and turnkey systems for the power generation market.

CBEPT's main business is the complete design, engineering, supply and commissioning of mechanical bulk materials handling systems for coal, biomass, waste, ash, mill rejects, limestone and gypsum.

Our experience is well proven in many successful installations in coal fired power plants, waste-to-energy and biomass plants.

A complete range of solutions for an efficient business.

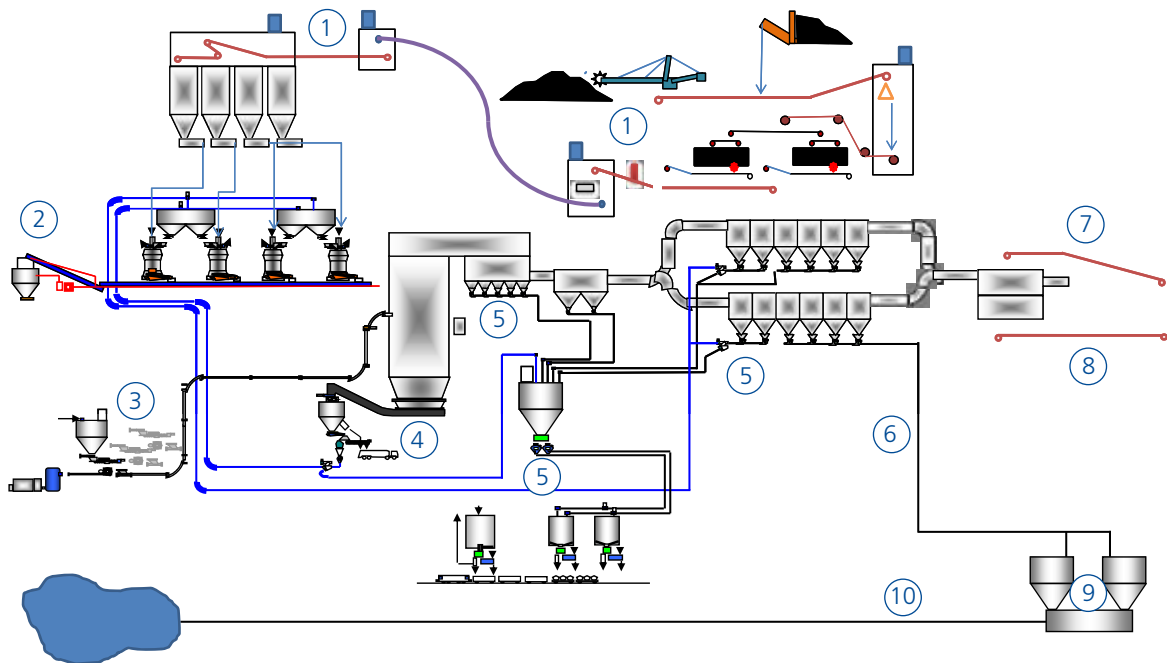
Both Clyde Bergemann Materials Handling and Clyde Bergemann EP Tech are completely oriented to the needs of the customers, offering a complete and efficient range of solutions.

Our understanding of the design and construction process from initial survey to ultimate delivery including operate and maintain, and our ability to bring relevant expertise to a project gives us the capacity to deliver cost-effective projects that meet client requirements on time and within budget.



Providing an extensive solution portfolio

Our solution portfolio for reliable handling and removal of ash, exemplarily shown at a typical PF coal-fired boiler plant:



① Coal, RDF, biomass & sub-materials mechanical feeding

② Mill rejects removal

③ Injection technology

④ Dry or wet bottom ash conveying

⑤ Dense and lean-phase pneumatic conveying

⑥ Long distance pneumatic conveying to silo

⑦ Limestone feeding to FGD

⑧ Gypsum handling and storage from FGD

⑨ Storage silos and discharge

⑩ High Concentration Slurry Disposal to ash pond / lagoon



Turnkey mechanical handling solutions



Mechanical conveying solutions for solid fuels, limestone and gypsum

We provide complete, robust and efficient solutions for solid fuels feeding such as coal, coke, waste/refuse derived fuel, biomass, limestone and gypsum.

Our turnkey systems cater for the most difficult kind of materials including coarse, hot, abrasive, sticky and humid bulk materials.

Our product range includes belt, tripper, chain and redler/apron conveyors as well as bucket elevators, systems for coal stacking, reclaiming and truck unloading, covering all the needs of the power field.

⚡ Your advantages

- Suitable for large size and sticky material
- High transportation capacity
- Reliable for heavy duty applications



Mechanical ash extraction systems

We supply complete systems for mechanical ash extraction in the heaviest conditions with the most difficult kind of ash, not only in coal-fired power plants but also in incinerators and in biomass plants.

Upon the above, our mechanical systems for ash extraction are engineered for easy maintenance and long life.

⚡ Your advantages

- Suitable for high temperatures
- Affordable costs
- Low power consumption





Mill rejects removal systems

Mechanical removal systems for mill rejects

The mill reject evacuation system, synthetically called pyrites systems, is a flexible and reliable solution for the automatic mechanical removal of the mill rejects in coal-fired power plants

Thanks to our systems, all the minerals rejected by the mills are handled in a totally enclosed system up to storage silos.

It is also possible to select and separate the output material using the appropriate equipment in order to separate coal dust, coal granules, ferrous elements and recycle combustible elements back to the mills.

We help our clients to carry out the best choice, suggesting the most responding solution to their needs. We develop and supply completely automatic turnkey systems, as well as semi-automatic and manual systems when requested, adhering to ATEX where required.



Our design is orientated towards the most critical operating conditions in terms of plant layout (available space around the mills), quality of the material handled (high contents of large size pyrites) and mills efficiency (frequent trip condition of the mills).

All our systems are fully designed and tested complying with all the requested rules for explosion resistant equipment and for unfired pressure vessels (e.g. EN 14460, EN 13445) and they are complete with all the necessary safety devices in the event of gas emission in the atmosphere, fire or explosion in the presence of carbon dust air mixture.



⚡ Your advantages

- Lower installed power
- Lower wear and maintenance
- Higher efficiency
- Compact solution
- Short pay back period
- Low cost of required spare parts



Dry bottom ash handling with DRYCON™



Clyde Bergemann offers most types of bottom ash conveying systems customised to meet the individual project requirements.

DRYCON™, is our 'dry' bottom ash handling solution, which can be applied in coal-fired boiler or waste-to-energy plants. The system poses many benefits which includes protection of the environment, elimination of energy wastage whilst benefiting from profitable ash quality and capitalising on rising ash demand by industry as well as profit from significant lower life-cycle costs compared to wet ash handling.

With environmental protection regulations getting tougher worldwide, the choice for DRYCON™ is an investment in the future in order to save precious water, reduce emissions and return heat energy to the boiler resulting in lower coal usage and so with lower costs for emission trading.

DRYCON™ can be retrofitted into existing applications where space is a premium therefore contributing to the continued life span of the power generation facility.



Sophisticated construction and valuable features:

- The modular construction principle allows flexible adaptation of length-width ratio guaranteeing efficient ash cooling at maximum extraction rate
- Design of the apron plate conveyor avoids direct heat transfer and dust wear into the drive chain, support idlers and other moving parts
- Impacts of large ash lumps are directed onto impact beams - no stress to any important moving parts



⚙️ Your advantages

- No precious water wasted for ash cooling and conveying and avoidance of all related water treatment costs
- Re-burning effect of heat energy from ash increases boiler efficiency, reduces coal usage and CO₂ emissions
- Dry bottom ash handling means higher ash quality with less carbon realising increased ash sales
- Low life-cycle costs



Solutions for wet bottom ash handling

Submerged Scraper Conveyor (SSC)

The SSC is used for the continuous removal of furnace bottom ash from conventional pf-fired boilers and is particularly suited where headroom is limited. The system is capable of quenching and transporting over 100 tonne/hour of ash and offers greater energy efficiency than hydraulic systems of comparable capacity. A double roller crusher feeds the ash either to a slurry disposal system or onto belt conveyors for onward transfer.

This technology can adopt single or twin hydraulic or electro-mechanical drives to suit the application or customer requirements. Trial assembly prior to shipment can ensure a seamless installation programme avoiding timely delays in re-work.

Clyde Bergemann SSC's have been designed for up to 1,000 MW boilers, up to 50 metres in length, to handle 140 tonnes of stored ash.

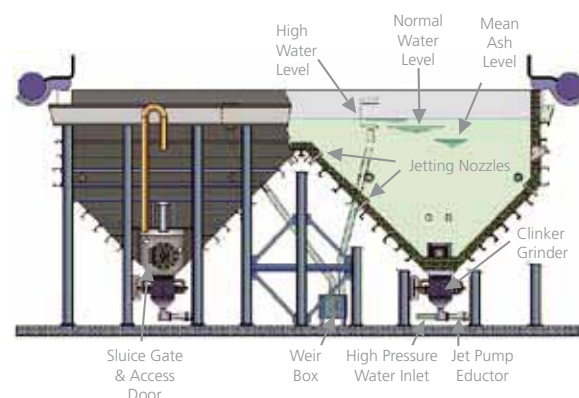
☛ Your advantages

- Continuous removal technology is superior to hydraulic systems due to reduced water usage, power consumption, process complexity and lower operational and maintenance costs
- Automatic chain tensioning reduces time and resources spent for this task and increases chain life expectancy
- Driving chains are specifically designed for the challenging conditions at power plants



Water impounded hopper

The water impounded hopper collects the bottom ash from the furnace and then transports it by means of a hydraulic sluicing pipeline to a de-watering bin, settling tank, surge tank or lagoon. Conveying rates of up to 150 tonnes/hour can be achieved with this technology.





Flexibility in pneumatic conveying solutions



A range of options to suit applications

Within our solutions portfolio we can supply all boiler ash handling needs. Our reputation has been gained mainly in the field of pneumatic conveying with options for dense and lean-phase solutions.

Dense-phase solutions

Our dense-phase solutions use modern technology and high pressure air to convey 'plugs' of materials through smaller pipes. Handling of fly ash from electrostatic precipitators filters, fabric filters, economisers and air heater hoppers can be carried out by using one of our specifically designed pressure vessel systems to convey the material up to and above 1,000 metres into a storage silo.

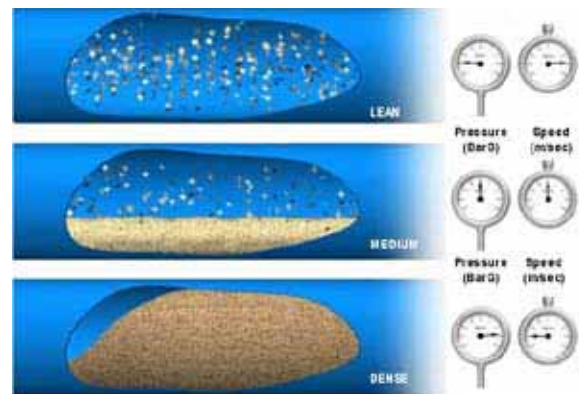
Our dense-phase family are all equipped with the world renowned Clyde Bergemann Dome Valve®.

We engineer and supply comprehensive solutions including all necessary key and auxiliary components like pipes, bends, switch valves, dump valves and terminal boxes.

Lean-phase solutions

Lean-phase conveying is the method of choice when special process requirements have to be met.

Lean-phase conveying systems can be offered as pressure or vacuum systems. Our systems feature special abrasion resistant elbows and valves to extend life and minimize maintenance.



Advantages of dense-phase technology:

- Pipe savings: small standard pipes sufficiently less wear
- Maintenance savings: 50-80% savings due to less wear and reduced equipment
- Standard compressed air requirements: more easily obtained and less standby equipment required
- Energy savings: 30-50% reduction in real costs

Advantages of lean-phase technology:

- Low headroom at pick-up points
- Little to no "dusting". Leaks are inward
- Clean and reliable technology
- Can be designed to handle varying particle sizes



Solutions for slurry transportation

Slurry is a by-product of the coal combustion process and consists of solid and liquid waste. Our specialised solutions for slurry transportation ensure effective conveying is achieved and take into consideration such things as long distances and large ash lumps.

Our solutions would generally fall into three categories:

- High Concentration Slurry Disposal
- Conventional lean slurry system
- Hydraulic eductor, ejector or jet pump system

High Concentration Slurry Disposal (HCSD) system

This uses significantly less water, using 15% water or less by weight, and is used generally to transfer high throughputs of fine fly ash over very long distances using high pressure diaphragm pumps with velocities of around 2 m/s. Systems such as this have been installed for over 10 kilometre transfer distance. Ash disposal at the ash mound is very simple as the ash solidifies easily into an inert mass and the system does not produce the waste water problems or leachate problems normally associated with ash lagoons.

⚡ Advantages of the HCSD system:

- Uses 15% or less weighted water
- High throughputs transferred over very long distances over 10 km
- Reduced waste water and leachate problems

Conventional lean slurry system

This uses a motorised pump (generally centrifugal) to transfer a water / ash mixture at high throughputs over long distances to an ash pond or lagoon. This can also handle both very coarse and fine ash with lumps of up to 50 mm.

⚡ Advantages of lean slurry system:

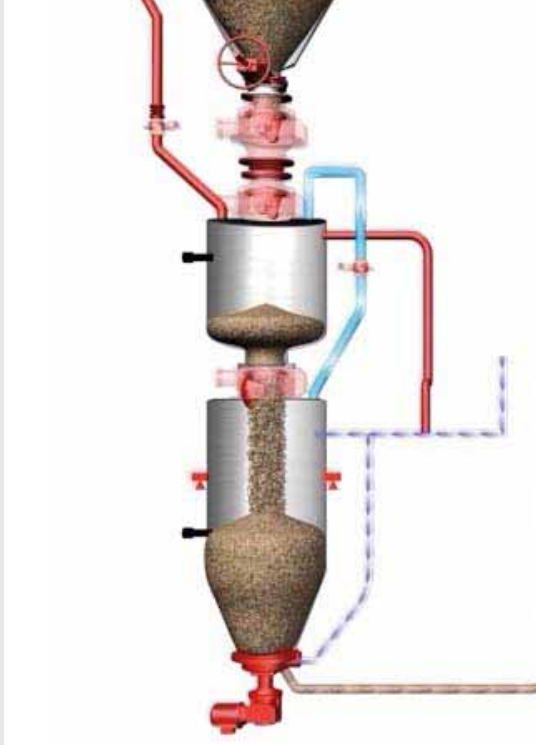
- Established technology
- Handles a wide range of materials with different particle sizes and densities
- Handles large throughputs and conveys long distances
Flexible and easily re-routable

Hydraulic eductor, ejector or jet pump system

This uses a water induced vacuum to evacuate material from a collection point or hopper and transfer this to a local sump. This type of system can handle large ash lumps (up to 50mm) but is limited to around 30 tph transfer rate and 200 metres distance. Water to ash ratio is around 4:1 by volume.

⚡ Advantages of hydraulic eductor, ejector or jet pump system:

- Excellent mixing and conveying properties
- Can operate on a continuous or batch basis
- Suitable for single or multi pick up point applications
- Suitable for applications with restricted height



Boiler feed injection technology



Clyde Bergemann has an extensive portfolio of injection technologies for boiler injection, as well as systems for emission reduction. With 40 years of experience in this field, we offer high quality cost effective solutions to power plants worldwide.

Our range of boiler injection solutions offers both pneumatic and mechanical options for efficient injection of various materials.

Rotofeed® Injection

The Rotofeed® technology has applications in the injection of coal, other fuels and limestone into the re-injection of ashes and grits into fluidised bed combustors, the injection of limestone into FGD processes, and any other applications where direct material feed into the process is required.

Some of the main highlights of the technology include:

- Continuous feed rate accuracy $\pm 2.0\%$ by volume
- Handles wet or dry, power or granular material
- Conveying rates up to 100 tph of distances up to 500 metres
- Feed rates unaffected by pressure fluctuations
- Back pressures up to 20 bar(g) installed
- Low air consumption and high materials-to-air ratio
- High accuracy loss-in-weight control available $\pm 0.5\%$ by weight
- Can be designed for explosion containment

PERMA/flo Extreme Rotary Valve Injection

PERMA/flo extreme rotary valve injection (utilizing SPLIT / flo FLO / proportioner splitter technology) has applications in the injection of coal, other fuels, biomass, limestone and bed sand into the re-injection of ashes and grits into fluidised bed combustors, the injection of limestone into FGD processes, and any other applications where direct material feed into the process is required.

Some of the main highlights of the technology include:

- Even flow distribution, using patented splitter technology
- Capable of up to 8 splits for even distribution into the boiler/furnace
- Reliable equipment designed for 24 hour operation
- Over 40 years of continuous injection system experience
- Extreme rotary valve: Fully adjustable rotor to shoe clearances allowing for factory like clearances at each adjustment.
- Motive air source: Positive displacement blowers operating at under 1 bar (g)
- PERMA/flo abrasion resistant pipe & fittings available for extended wear life in the convey line.



Materials storage and discharge

Storage system design considerations:

- Expected holding volume based at Maximum Combustion Rate (MCR) or design operating conditions
- Materials of construction, either concrete or steel is the preferred method dependent on physical diameter and height.
- Ash utilisation: is coarse and fine separation required
- Roof configuration, number of conveying pipes, filtration devices, access, instrumentation, classification equipment, etc
- Silo discharge arrangement including number of outlets, outlet configuration and type of fluidising system
- Wet or dry unloading systems into tankers, trucks, rail cars or second stage transport using belt conveyors
- Demands from third party ash utilisation companies, for example cement companies could take a large quantity of the finer ash for inclusion in their own processes



Storage silo outlet configuration:

Steel silos are normally designed with a concrete outlet and a minimum valley angle of 60 degrees ensures mass flow during silo emptying. Additional air injection points or fluidising pads are fitted to the lower section of the silo outlet to prevent bridging or blocking in the silo outlet.

Fluidising slides are fitted in to the base of the concrete silo to promote flow of material through multiple discharge points. Low pressure roots blowers or fans are used to generate the motive air for silo fluidising and aeration

Silo discharge equipment:

Normally silos are emptied continuously or discontinuously in a dry or wet condition depending on the power plant operating regime. The paddle mixers, otherwise known as ash conditioners, can be used to humidify the dry ashes at discharge rates of up to 250 tph. Water consumption is generally dependent on process application although 5 to 25% is generally a typical range.

Other kinds of hydraulic mixing devices can also be adopted depending on final requirements, these could include hyjectors and sluicing channels.

Dry ash loading is more commonly used when discharging to road tankers for re-sale into other process industries. This kind of telescopic unloader comes in many different configurations to suit a wide range of applications.

In some instances it may be necessary to control and monitor the amount of ash discharge and in these cases flow monitoring or weighing devices can be engineered to suit every application.

Clyde Bergemann is represented in over 40 countries worldwide



- Clyde Bergemann Companies
- Clyde Bergemann Associates



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