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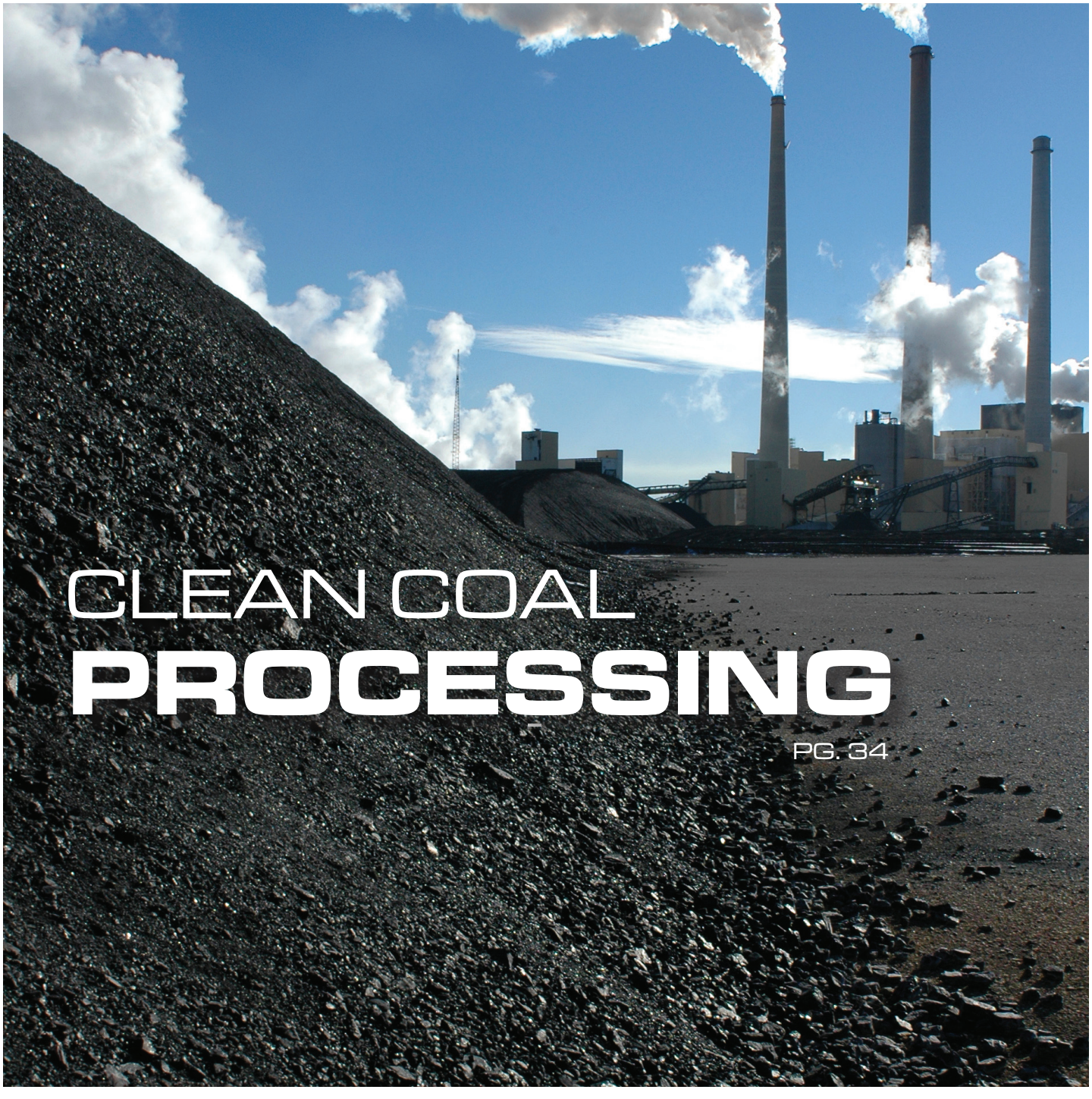

CLEAN COAL PROCESSING

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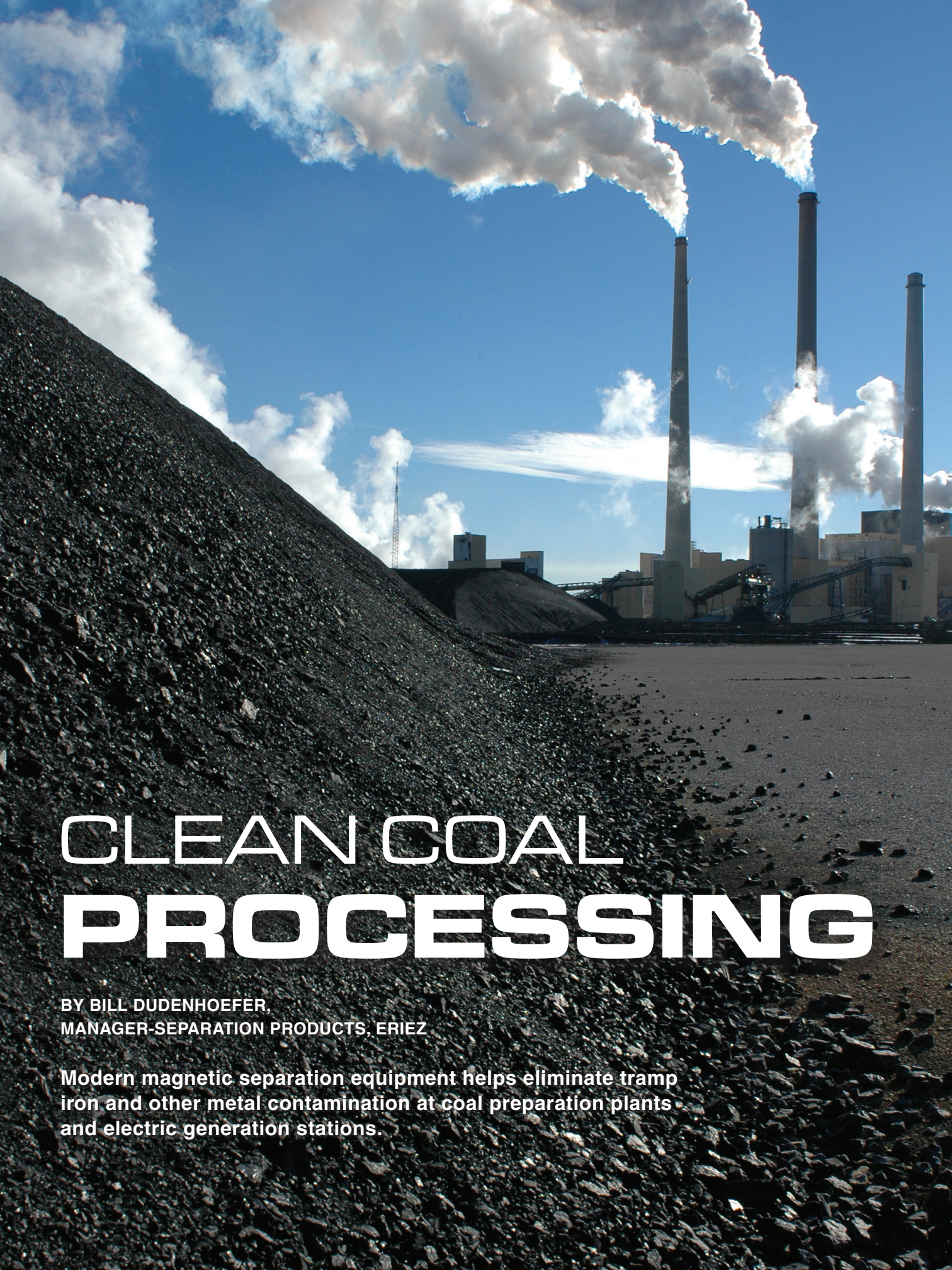

CLEAN COAL PROCESSING

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Modern magnetic separation equipment helps eliminate tramp iron and other metal contamination at coal preparation plants and electric generation stations.

Because of its low cost and abundance, coal comprises almost 50% of the U.S. generation portfolio. Coal, like other fossil fuel supplies, takes millions of years to create, but releases its stored energy within only a few moments when burned to generate electricity. Because coal is a finite resource, and cannot be replenished once it is extracted and burned, it cannot be considered a renewable resource.

Usually, coal is utilized to convert water into steam in boilers. Coal is pulverized into fine powder, for proper combustion, and then it is fed to boilers for steam generation. The steam is then used to drive steam turbines. The turbine shaft is coupled to a generator shaft which generates electricity.

The process of cleaning coal begins at preparation plants and ultimately ends while the coal is being pulverized and conveyed into the electric utility's coal feeders. At multiple points along this journey, tramp iron and other metal contaminants are eliminated using modern magnetic separation equipment – from suspended electromagnets to metal detectors. Removing tramp iron from the coal processing stream reduces damage to an electric plant's conveyor belts, pulverizers and coal feeders, and allows electric plant operators to burn a cleaner type coal free of metal contamination.

A variety of sources can lead to metal contamination. Metallic foreign objects are picked up during the mining stage or brought along during transport by rail, barges, ships, or trucks. Magnets collect an odd assortment of wire, rail spikes, roof bolts, drill bits, blasting caps, plates, shovel blades, and other metal which is accumulated during the mining, transportation, and processing stages.

AFFECTS ON OPERATIONS

How much can tramp iron affect a utility's operation? One Midwest coal-fired plant experienced more than 70 incidents at its coal feeders and 125 incidents at the pulverizers because of metal contamination. These incidents decreased the plant's availability by 371,000MWh and cost more than $500,000 in repairs. The incidents decreased when the plant upgraded its magnetic separation equipment by partnering with Erie, PA-based Eriez.

The use of specialized magnetic separation equipment for coal processing involves a variety of magnet strengths, models, and operating efficiency. For example, suspended electromagnets (SEs) help remove tramp iron from conveyor lines, while metal detectors are sensitive to ferrous and nonferrous metals and are built for use in rugged environments.

What follows is the type of magnetic separation equipment commonly used, and how it works to remove harmful foreign metal objects from coal. This equipment is found at both coal preparation plants and electric generation facilities.

SUSPENDED ELECTROMAGNETS

The electromagnet is typically mounted or suspended over a conveyor belt to remove large pieces of tramp metal that can cause damage to coal crushers, grinders, and pulverizers. Suspended electromagnets also remove sharp metal that can damage or tear expensive conveyor belts, especially at transfer points.

Suspended electromagnets consist of several components to provide the magnetic force necessary to collect large pieces of tramp metal. The coil, core, backbar, and steel enclosure provide an efficient and effective magnetic circuit for collecting tramp metal.

Suspended electromagnets are available either in manual cleaning or self cleaning models. Manual cleaning units are cleaned of accumulated tramp iron by turning off magnetic power periodically. Self cleaning models provide completely automatic iron removal and can be installed in an in-line (parallel to the conveyor belt) or cross belt (perpendicular to the conveyor belt).

These rugged magnets are typically mounted in one of two positions over a conveyor belt: Just over the stream of material leaving the head pulley or just over the conveyor belt prior to the head pulley.

Those who operate suspended electromagnets need to be aware of the size of ferrous contamination as it affects their operation. Small pieces of tramp metal (i.e. ½" hex nut, 1" cube, etc.) are extremely challenging to remove, especially when pieces are covered by a heavy burden of coal material compared to large metal like loader teeth or rail spikes. That's when other magnetic separators come into play.

PULLEYS

These powerful and reliable workhorse units provide automatic separation of heavy tramp iron from conveyor transported materials. Permanent Magnet Axial Interpole Pulleys (AIP Pulleys) transform a belt conveyor into a powerful self-cleaning magnetic separator.

AIP pulleys are widely used as head pulleys in belt conveyors. The tramp iron running down the belt conveyor comes within the pulley's magnetic field as it reaches the end of the conveyor. The tramp iron is attracted and held to the belt until it reaches the underside, passes out of the magnetic field, and is separately discharged. The clean, non-magnetic material is discharged over the pulley in a normal trajectory.

There are some instances where an electromagnetic pulley is used rather than a permanent AIP pulley. Electro pulleys are used for difficult iron separation problems involving high speeds, heavy burden depths and hard-to-separate materials.

Standard sizes for AIP pulleys typically range from 8" to 36" in diameter, with belt widths from 8" to 60". Normal sizes for electro pulleys range from 19" to 48" in diameter having belt widths from 12" to 60".

METAL DETECTORS

Any type of fine metal can enter the production process with the raw coal material or can get into the product because of wear or failure of processing equipment components. Detecting pieces of broken machinery can help solve problems before major damage occurs.

Metal detectors, such as Metalarm Metal Detectors, are extremely sensitive instruments used to detect the presence of ferrous and nonferrous metals, making them ideal to protect pulverizers and coal feeders.

Modern metal detectors operate for long periods of time, frequently in adverse environments, with little attention to maintenance. The power required to operate both the detector and the reject drive (if any) is minimal, even if a special conveyor is needed to pass the product through the metal detector. Metal detectors can be configured to reject the contaminated product automatically, even if the rejection point is some distance from the detector.

VIBRATORY FEEDERS

Although this equipment is not specifically engineered to separate foreign objects from raw material, it does play an important role at coal preparation plants and generation facilities.

Plant operators rely on heavy-duty, high-capacity feeders for the controlled movement of coal. The Eriez Model HVF mechanical feeders, for example, are simple, rugged, vibrating units that move high volumes of bulk coal reliably and economically. The compact, straight–line design results in a low-profile feeder requiring minimum headroom.

Vibratory feeders are capable of moving large quantities of coal through the processing facility. The basic models with accompanying trays can feed up to 80 tons/hour, while more advanced and rugged models can feed up to 850 tons/hour. Feeders work on a two-mass vibrating system, spring-coupled, excited by a motor-driven eccentric shaft. Adjustable angle rubber springs – of which each one can be removed and replaced in less than 2 minutes if necessary – transmit the exciting force and can fine tune the motion of the trough for a greater flow rate for specific coal processing.

Through the installation of advanced magnetic separation equipment, coal processing operations are running more efficiently than ever before.

WET DRUM MAGNETIC SEPARATORS

Wet drum magnetic separators are employed in the preparation plant to recover the magnetite used in the heavy media separation circuit. Recent innovations in both magnetic circuit design, and materials of construction, have been applied to wet drum magnetic separators to maximize magnetite recovery and minimize wear and maintenance.

The magnetic element is the most important feature of a wet drum separator. In the design of a magnetic separator, the magnetic field intensity, and the magnetic field gradient, are two first order variables that affect separation response. Although there are several variables influencing magnetic separation, the magnetic field strength is indisputably the foremost variable for high levels of magnetite recovery.

There have been recent technological advancements in the design and modeling of magnetic circuits. Precise magnetic circuit modeling and optimization is now carried out using multi-dimensional finite element analysis. The North American industry standard is the Eriez 950 gauss Interpole magnetic element. This magnetic element maximizes the magnetic field strength and gradient resulting in high levels of magnetite recovery.

The counter-rotation wet drum tank style is preferred for heavy media applications. The drum rotates against the slurry flow in the counter-rotation tank style. Any magnetite that is not immediately collected will pass through to a magnetic scavenging zone. The short path that the magnetic material must be conveyed – between the feed entry point and the magnetics discharge lip combined with the magnetic scavenging zone – results in high magnetite recoveries.

Essentially all wet drum tanks used in heavy media applications have leveling spigots and a full width overflow that must be maintained during operation. A deviation in the overflow may result in inefficiencies in the performance and the loss of magnetite. A modification of the counter-rotation wet drum tank represents a recent development in technology for heavy media wet drum magnetic separators. The self-leveling tank has no discharge spigots to adjust or monitor and maintains a constant slurry level at any flow rate.

When a wet drum magnetic separator is properly applied, the magnetite loss will be less than 0.25g of magnetite/liter of effluent. This generally equates to a magnetite recovery in the 99.8% to 99.9% range.

MODERN MAGNETIC SEPARATION

Modern magnetic separation equipment is essential in the removal of tramp iron for coal processing. Since pull strength of today's magnets is much greater than its predecessors, magnetic separators are an even more effective tool for preventing costly damage and shutdowns. Through the installation of advanced magnetic separation equipment, coal processing operations are running more efficiently than ever before.

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