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Automated gas conditioning

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Autojet Technologies, a division of Spraying Systems Co, has recently introduced its new automated gas conditioning system onto the cement market. Tried and tested by Maoling Shengli Cement in China, this new turnkey system has proven to demonstrate 'superior evaporative and cooling performance.' A high-level technical overview of the system, which can be used in several areas of a cement plant, together with the results of the Maoling installation case study are discussed below.

Automation of gas conditioning systems is certainly not a new concept. For decades, cement plant personnel have chosen systems with limited control capabilities. Or, they have created their own systems by integrating hydraulic or air atomising spray nozzles and lances with pumps, compressors, sensors and controls from a variety of suppliers. In the latter approach, cement plant engineering personnel 'configures' and installs the components. If system performance issues arise, plant personnel are faced with contacting multiple vendors to coordinate troubleshooting efforts. While these systems can be quite effective, the amount of hands-on involvement is often significant. The end result is a gas conditioning system that may offer unattended operation when performing properly but requires significant attention for installation and maintenance.

A new, automated, gas conditioning system solution has been introduced recently by AutoJet Technologies, the systems division of Spraying Systems Co. This turnkey system offers total system control built around the most efficient, air atomising spray nozzle available. The AutoJet® Gas Conditioning System maximises the performance of the high-efficiency, FloMax® Air Atomising Nozzles in the system, providing users all the benefits of complete automation, along with superior system performance.

High-level overview

The AutoJet Gas Conditioning System provides effective gas temperature control, gas volume reduction and humidification using evaporative cooling. High-efficiency, air atomising nozzles are used in the system because of performance and cost advantages over hydraulic nozzles.

FloMax Air Atomising Nozzles are the 'heart and soul' of the system (see Figure 1). A patented, three-stage, atomisation process produces very small drops using minimal air. Drop size testing has determined the drops are 34 per cent smaller utilising 20 per cent less air than competitive nozzles. These very small drops reduce the dwell time required for complete evaporation and provide greater surface area per gallon of the sprayed liquid. This results in a more complete reaction and total absorption without wetting. In addition, small drop size lowers energy costs and extends compressor life. The nozzles also allow for turndown of flow rate to maintain air pressure while liquid pressure and flow vary.

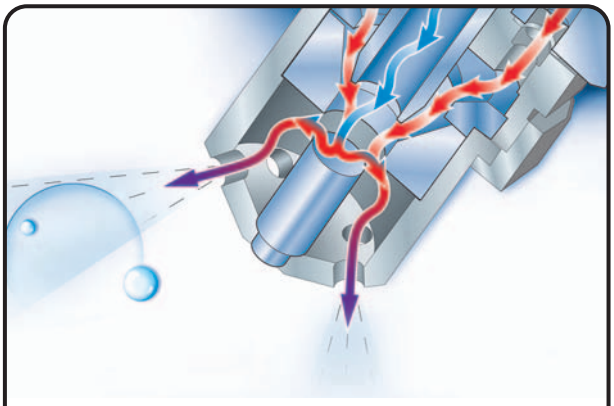


Figure 1: patented, three-stage, atomisation process results in a finely atomised spray

The AutoJet® Spray Controller is the 'brain' of the system. See Figure 2. It controls all gas conditioning system components and other hydraulic and pneumatic components if needed. The controller monitors and adjusts the closed-loop system. Liquid and air flow to the nozzles are regulated based on data gathered from RTD temperature sensors, resulting in the highest possible level of system responsiveness and accuracy.

Other system components include pumps, liquid regulators, sensors and optional air compressors. Lances, adapters, cooling jackets, purge tubes and protective tubes typically complete the system.

How the system works

Using closed-loop temperature control, the system is capable of holding very tight tolerances (see Figure 3). The spray controller, responding to input from temperature sensors, calculates the exact liquid and air pressures required to maintain drop sizes and achieve efficient cooling. Some systems use two-stage cooling. A typical first stage may cool the gas temperature in the kiln feed hood from 760°C (1400°F) to 343°C (650°F). The second stage may cool the gas temperature in the cooling tower from 343°C (650°F) to the optimum temperature of 163°C (325˚F).

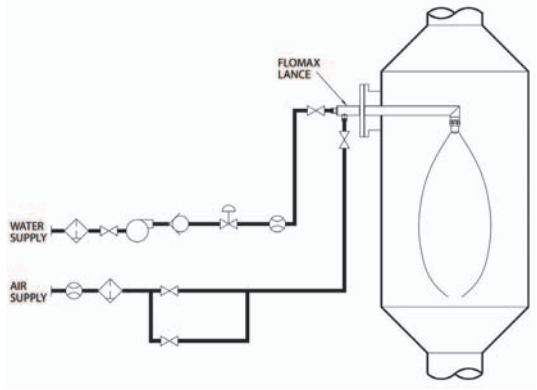
To optimise system efficiency and performance, the spray controller monitors:

- liquid pressure
- atomising air pressure
- nozzle/lance activation
- external process conditions including temperature and humidity
- flow rates
- system integrity checking and error handling.

If unacceptable variations in process

Figure 2: control of all system components is provided by the spray controller closed-loop

Figure 3: automated system utilises closed-loop temperature control.



conditions are detected, the controller will automatically correct them. Response time is fast and ensures maximum system performance. If the controller cannot resolve the problem, operator warnings will be displayed or sounded and handled as priority signals, interrupting the microprocessor. Typically, operator intervention is minimal.

The spray controller also saves on programming time compared to other control devices. It is easy to use and is equipped with complete gas cooling and spraying data. A menu system guides the operator through set-up and any configuration changes. The controller is pre-programmed and pre-tested prior to shipping to reduce installation time and ensure full functionality immediately (see Figure 4).

If required, the gas conditioning system can be integrated into existing control systems. Direct wiring and current splitters can be used for access to critical data. For full control of all available data, a communications protocol such as OPC (Object Linking and Embedding for Process Control) can be incorporated to enable remote control and monitoring.

The liquid line includes double filtration and typically uses redundant Variable Frequency Drive (VFD) pumps to provide proportional liquid regulation and significant electricity savings. The air line includes air filtration and either manual or proportional air regulation with its bypass. Proportional air regulation is used when a high turndown ratio is required and energy can be saved by accurately monitoring air flow. Minimal air flow is maintained through the nozzle at all times to prevent clogging by ashes or dust in the gas.

Systems can be configured with multiple lance zones to allow even greater turndown of flow rate under variable system conditions. The spray controller can control multiple lances in multiple zones.

Typically, fewer nozzles are required for cooling in an AutoJet Gas Conditioning System because of the large flow rate per FloMax nozzle. As a result, smaller cooling towers can often be used and the initial installation cost of the system is less than other systems.

Figure 4: pre-programmed spray controller is easy to use and enables quick set-up and operation

	Status of the nozzle output: the system is in RUN mode but the nozzle not spraying. When this symbol is not shown then the system is in stand-by.
	Status of the nozzle output: the system is in RUN mode and the nozzle is spraying.
	This symbol is used to indicate to the user that he can enter a sub menu by pressing the key arrow right.
	This symbol is used to indicate to the user that he can jump to the parent menu by pressing the key arrow left.
	This symbol is used to indicate to the user that he can enter a sub menu by pressing the key arrow right or jump to the parent menu by pressing the key arrow left.
	This symbol is used to indicate to the system is working in manual mode.
PgUp	This symbol is used to indicate that you can use the Page Up key to go to the previous page of the menu list.
PgDn	This symbol is used to indicate that you can use the Page Down key to go to the next page of the menu list.
PgUp PgDn	This symbol is used to indicate that you can use the Page Up or Page Down key to go to the previous or next page of the menu list.
123 NUM	This symbol is used to indicate that you can enter a decimal number.

Areas for use

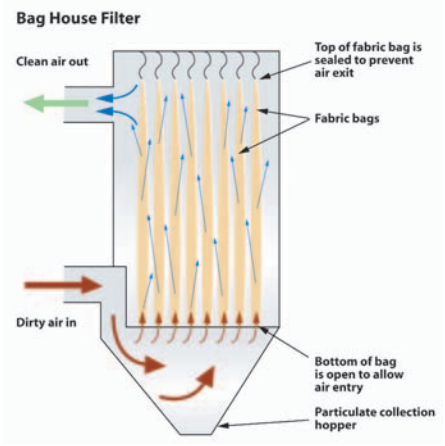
The AutoJet Gas Conditioning System can be used in several areas of a cement plant:

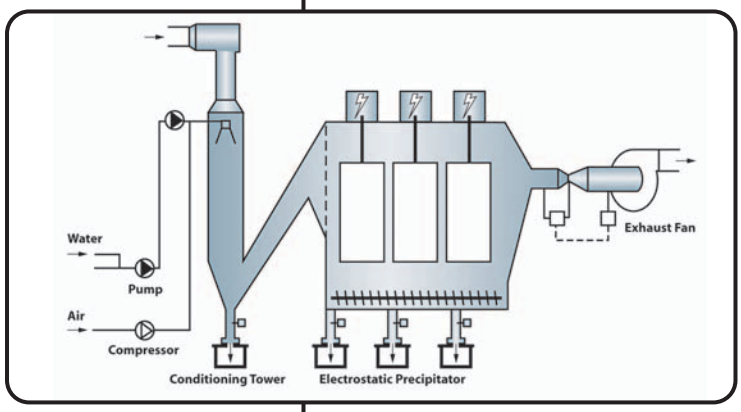
- prior to the electrostatic precipitator (ESP) to control gas inlet temperature and humidity for optimum efficiency
- prior to baghouse entry to eliminate fire risk and clogging due to mud build-up in filters from overwetting
- in cooling towers
- in rotary dryers, kiln feed hoods and clinker coolers (see figures 5 and 6).

Documented benefits

Cement plants can experience many benefits from using this system:

- precise control of temperature and humidity maximise dust collection and ESP performance
- reduced maintenance time to clean ducts, kiln feed hoods, tower walls and bottoms and to monitor, repair and restart equipment
- significant reductions in the creation and





Figures 5 and 6: the automated system is typically installed to maximise performance of ESPs and protect baghouses

release of toxic dioxins and furans and lower costs associated with government compliance

• lower energy costs due to optimised ESP performance.

An example of the effectiveness of this automated system follows. Other cement plants in the USA, Europe, South America and Asia are experiencing similar results.

Case study – MaoMing Shengli Cement

Excessive emissions were a major reason why MaoMing Shengli Cement closed its door. Pollution issues were significant, but quality problems abounded as well. A hydraulic gas cooling system was being used with poor results. Bottom wetting, nozzle clogging and overly high gas temperatures prevailed. The management staff of MaoMing Shengli knew there were many issues to resolve before the plant could reopen. Installing a new gas conditioning system was among the first steps taken.

MaoMing Shengli management requested proposals from several manufacturers. The AutoJet Gas Conditioning System was selected for the following reasons:

• the ability to achieve the desired reductions in gas temperature and volume

• the reduction of emissions to an acceptable level – under 20 per cent opacity

• increased ESP throughput and production gains due to consistent gas temperature

• the operating efficiency of FloMax nozzles and reduced energy requirements

• the nozzle's maximum free passage, which eliminated clogging

• the projected reduced cost for on-going system operation and maintenance.

MaoMing Shengli's new, automated system consists of the pumping system, lance and three FloMax nozzles. Changes to the piping system were minimal. One liquid pipe was converted to air. High-pressure pumps were replaced with more efficient, quieter, medium-pressure pumps. The plant had an existing air source and it is being reused with the new system.

Before and after

Performance requirements:

Cooling tower: height: 26m
diameter: 6m.

Before system installation:

Inlet temperature: 275° to 295° C
Since the plant was not operating at capacity, gas temperature was low.
Outlet temperature: 130° to 150° C
Gas volume: 250,000 AM^3/h
Water volume: 7.2 to 8.9tph.

After system installation:

Inlet temperature: 350°C
Outlet temperature: 140° to 150°C
Gas volume: 200,000AM^3/h
Water volume: 6-9tph

As MaoMing Shengli increased production, gas temperature has been consistently held at 350°C. Gas volume has been reduced from 250,000AM^3/hr to 200,000AM^3/hr. While water volume has remained the same, the finely atomised drops evaporate completely and wetting is no longer a problem.

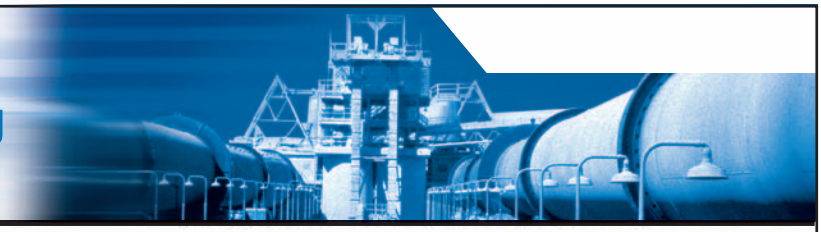
The system has been operating trouble-free for approximately six months. The reduction in unscheduled downtime and the resulting increased production has enabled MaoMing Shengli to recoup the investment in the new, automated system in just over four months. Other notable savings have resulted from reduced maintenance time — workers no longer have to clean sludge caused by wetting. Lower equipment and energy costs comprise the rest of the savings.

The Vice General Manager at MaoMing Shengli Cement states: "Since the installation of the AutoJet Gas Conditioning System in our cooling tower, the performance has been outstanding and has played an important role in ensuring steady production. The whole system is well-designed. It allows automatic and manual control as well as safety control to deal with a variety of operating conditions. Plus, we have been impressed by the good service after the sale – even after payment was made. The additional service calls were due to problems other than the AutoJet Gas Conditioning System."

Conclusion

While the interest in and level of automation required for gas conditioning will vary from cement plant to cement plant, the AutoJet Gas Conditioning System provides plant personnel with a new option. Configuration and operation is versatile so it can be used in various locations in the plant. It uses proprietary technology to ensure superior evaporative cooling performance. And, it is a turnkey system that facilitates installation and on-going operation. In summary, it removes some of the obstacles cement plants may have faced when considering automation and makes automation a more viable solution than ever before.

How to Solve Costly, Complicated Gas Cooling Problems Quickly

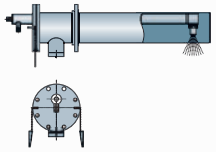


1.

FloMax
Air Atomizing Nozzles

- Small drop size – 100% evaporation
- Extremely energy efficient
- High turndown ratio

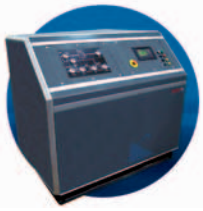
2.



Lances, Manifolds and Headers

- Quick-release or bolt-on flanges
- Adapters, cooling jackets, purge tubes and more

3.



AutoJet
Gas Conditioning System

- Totally automated system that maximizes the performance of FloMax nozzles
- Proprietary, closed-loop control system regulates air and liquid flow

If you're not using FloMax® Air Atomizing Nozzles for gas conditioning, you may be plagued by problems like these:

- Excess emissions
- Excessive maintenance time due to wetting
- High energy costs
- ESP overload

Only our FloMax nozzles or our AutoJet® Gas Conditioning System can help you gain control of gas temperature, gas volume and humidity. Plus, you'll experience a reduction in energy costs, unscheduled downtime, labor and maintenance problems. Patented technology — an atomization process and control system — results in an unmatched solution for gas cooling and that's why cement plants around the world rely on Spraying Systems Co.

Learn more today by requesting or downloading our new brochure on gas cooling at **www.spray.com/gasconditioning**. Or, give us a call at **1-630-665-5000** or **1-800-95-SPRAY** in the U.S.

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