



Temperature Control to Prevent Equipment Problems

Semi-Dry Fog® Kiln Cooling System



Fog offers excellent cooling performance and does not interfere with temperature measurements, thus helping to prevent equipment problems and achieve quick-response measures.

Customer Testimonial: Keisuke Takenaga, Manager, Production Administration Department, Ube Industries, Ltd.

Ube Cement Factory, Ube Industries Ltd.

The Ube Cement Factory boasts an annual production output of 1.8 million tons and is capable of producing standard Portland cement as well as around 50 different types of special cements including high-early-strength Portland cement and blast-furnace cement. They are equipped to provide society with the products needed to meet increasingly diverse and sophisticated demands. Ube Industries, Ltd. jointly developed the Semi-Dry Fog® Kiln Cooling System together with H. IKEUCHI & CO., LTD., and the system has been successfully patented.

Ube Cement Factory
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 (Please refrain from directly contacting Ube Industries or their factories about this article.)

Waste Products Increase Facility Wear

In an effort to help achieve a recycling-oriented society, Ube Industries was one of the first companies to introduce burnable waste products into operations as an alternative-energy fuel for clinker firing operations. They currently make use of more than three million tons of waste products and process byproducts in this way. However, such waste products contain high amounts of sulfur and chlorine, and increasing use of them as fuels has led to new problems: greater breakage of the refractory bricks in rotary kilns as well as accelerated brick dissolution.

Rising Kiln Maintenance Costs

Acceleration of rotary kiln wear and damage is not caused by waste-product usage alone; kiln cooling methods also contribute to these problems. This factory, for example, has long used an air-cooling approach for their kiln, but this method is only effective at cooling the limited areas on which air is directed. This air-cooling approach often provides insufficient cooling for the kiln as a whole, leading to dissolution and breakdown of coatings and refractory bricks, and in some cases thermal deformation of the kiln outer shell. Ube Industries' Isa Cement Factory previously used a water-cooling system, but this caused excessive cooling which led to acidic condensation buildup between the shell and bricks, resulting in gradual corrosion of the shell from the inside out. Furthermore, water cooling made it impossible to measure shell surface temperatures, which led to other potential problems such as inability to detect irregularities if they were to occur inside the kiln. For a variety of reasons, including increased use of waste products as fuel and unavoidable damage caused by traditional cooling methods, kiln maintenance fees have grown by a factor of seven or so over the last several years.

Fog as a Solution

In order to mitigate skyrocketing maintenance costs, the factory needed a new system that could provide visual displays of shell temperature distribution and optimize temperature control to prevent problems in advance and enable quick-response measures. IKEUCHI's fog technologies helped them achieve these very things. Although fog-based cooling has been around for some time, users say that traditional fog-spraying technologies do not provide sufficient fog volumes to cool entire kilns, and that systems are plagued with frequent spray-nozzle clogs. However, fog-based cooling systems actually offer numerous advantages over other types, such as permitting

temperature measurements which in turn enable visual display of thermal distribution across the shell, minimizing impact on the natural environment and surrounding facilities through the use of fully vaporized water, and greatly reducing total water usage. If, for example, it were possible to use large fans fitted with multiple fog nozzles on each to achieve greater fog-spraying and airflow volumes than previous systems to cool the entire kiln, to independently adjust fog and air-blowing volumes for each area of the kiln for more flexible temperature control, to move fans based on the kiln's shape, and to realize other such improvements, this factory could achieve optimal kiln cooling operations. With IKEUCHI, the facts speak for themselves. Ube Industries contacted their business partner, IKEUCHI, a manufacturer of fine fog* spraying nozzles and a pioneer in the field.

Comparison of Effectiveness by Cooling Method

Cooling Method	Overall Cooling	Localized Cooling	Temperature Control	Extension	Service Life	Environmental Preservation
Water Cooling 	Good	Fair	Fair	Fair	Fair	Fair
Air Cooling (Stationary Fans) 	Average	Fair	Good	Fair	Fair	Good
Air Cooling (Localized Fans) 	Average	Good	Good	Fair	Fair	Good
Fine-fog Cooling 	Good	Good	Good	Good	Good	Good

Maintenance-free 24 Hours a Day For 150 Days

IKEUCHI's system uses fans with attached nozzles, as described above, along with a fog-spray control panel and a scanning-type thermal-radiation thermometer to gather temperature-related information. Because the system uses industrial water, it features an Auto-Reverse Self-cleaning (ARS) Filter along with the various pumps, tanks and so forth. Additionally, IKEUCHI and Ube Industries built this system with a central focus on durability, designing it to operate maintenance-free 24 hours a day for 150 days' time. They built numerous prototypes and conducted multiple tests to prevent nozzle clogs, prevent rusting and algae formation on piping and tanks, and eliminate other potential problems. It took developers a full year to complete the system after starting development.

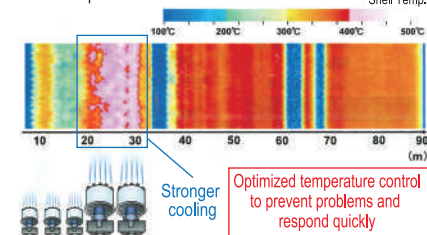
* Fine fog: a fog with a mean droplet diameter (droplet size) of 10-100 μm.

Quick Detection of Irregularities

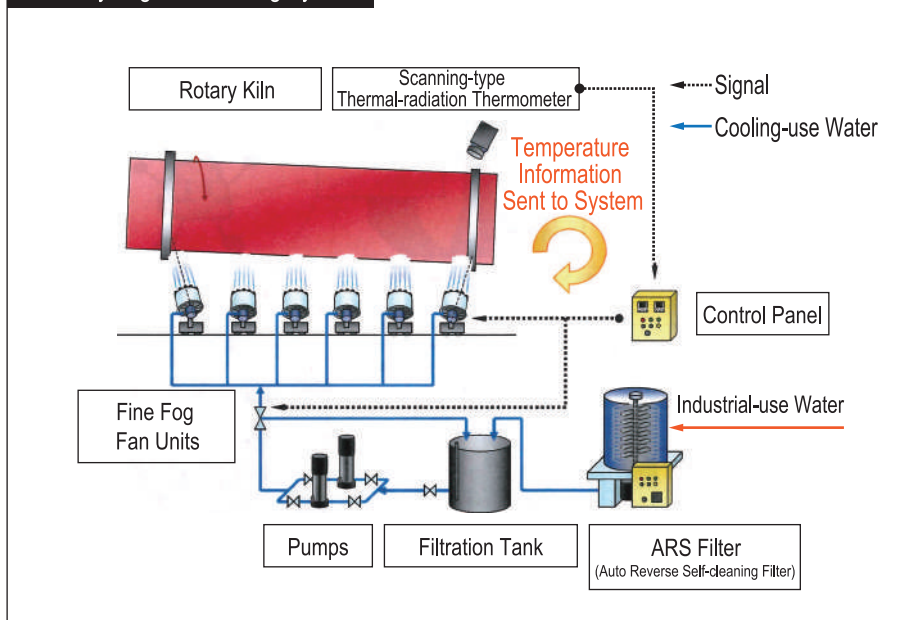
The completed Semi-Dry Fog® Kiln Cooling System was installed at the Isa Cement Factory, and concept-verification data was collected from its operations. The most readily apparent improvement over the former cooling system was the ability to adjust quickly in response to both insufficient and excessive cooling.

When the shell surface temperature dips below 200°C (392°F), spraying is purposely stopped to prevent acidic condensation, and air blowing is also stopped as needed to avoid excessive cooling.

When localized surface temperatures reach 400°C (752°F) or higher, concentrated fog spraying is carried out in these areas to cool them. By adjusting fan positioning, spraying angles and other such factors, it is possible to minimize coating loss, refractory brick dissolution and other such problems. Even if a brick were to break down or fall out, measures are in place to prevent thermal deformation of the kiln shell and enable continued operation.



Semi-Dry Fog® Kiln Cooling System



Eliminating Wastewater Eliminates Environmental Impact

The factory's former water-cooling system created standing water in the kiln and adjacent facilities, which had harmful effects on the equipment, facilities and working environment. The Semi-Dry Fog® Kiln Cooling System, on the other hand, uses fully vaporized water, which does not generate wastewater and thus maintains a clean operating environment at all times. Because the Isa Cement Factory is located inland from the sea, the ability to minimize environmental impact is beneficial from an ISO-certification standpoint as well.

Moreover, the fog-based system makes major contributions to water usage reductions: 6,500 liters of water per hour were needed to operate the old water-cooling system, whereas the Semi-Dry Fog® cooling system only requires 2,400 liters per hour.

Slower Refractory Brick Wear

The new system also reduces facility repair and upkeep costs. Refractory bricks inside the kiln are consumable components, and thus wear out gradually through everyday use. Although the rate of wear varies depending on kiln operating conditions and frequency, bricks usually require replacement about once per year.

At this factory, however, switching to the Semi-Dry Fog® Kiln Cooling System reduced the rate of wear and significantly increased brick service life.

The new system also provides visual displays of shell surface temperatures, which helps operators better understand coating-adhesion conditions. This in turn promotes improved attentiveness to temperature control among operators, which helps them maintain conditions that more effectively prevent dissolution and breakdown of refractory bricks.

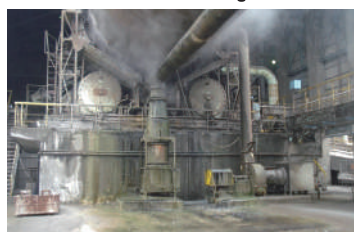
Ten-year Maintenance-free Operations

IKEUCHI later installed the same Semi-Dry Fog® Kiln Cooling System at the Ube Cement Factory as well. Following a short, initial setup and adjustment period, the new system is now set for ten years of maintenance-free operations. When installing a new system like this, it is important to avoid shunning durability considerations for other equipment and facilities in an attempt to cut initial installation costs alone. To prevent rusting and algae formation and achieve maintenance-free facility performance, it is necessary to spend enough money up front to build a strong system. IKEUCHI's cooling system delivers high cost performance, and the funds spent on initial installation are, without a doubt, recovered over time.



Environmental Improvements with the Semi-Dry Fog® Kiln Cooling System

Water Cooling



Water accumulates in and around equipment, increasing risk for accidents, environmental impact, etc.

Semi-Dry Fog® Kiln Cooling



No wastewater generated, thus preserving a clean operating environment

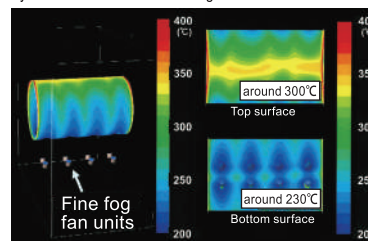
The new system offers improved ease-of-maintenance for equipment, and prevents oil leakages and environment-related accidents and problems

Semi-Dry Fog® Kiln Cooling System

Utilizing the Evaporative Cooling Effects of Fine Fog for Kiln Shell Cooling

Using this system's fine-fog spraying equipment to cool the rotary kiln's shell and keep it within a stable temperature range extends the kiln's maintenance cycle and thus its overall service life.

Furthermore, this system generates no wastewater, thus preventing contamination of the surrounding natural environment. IKEUCHI even offers simulation-based analyses (at extra cost) for visual representation of the proposed system's effectiveness following installation.



Specifications of the products and contents of this leaflet are subject to change without prior notice for purpose of product improvement.

Please feel free to send any inquiry, request for information or quote on this system to the contacts below.



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