

Combustion turbine inlet air cooling

MÜLLER-BBM
INNOVATION
EXPERIENCE
EXCELLENCE
SINCE 1962

BBM Akustik Technologie is the leading expert for complete acoustical solutions, high efficiency filtration and cooling systems for gas turbine intake with more than 50 years of experience. By offering customized high-quality products incorporating the latest technology, we set benchmarks in the fields of air intake and cooling systems and technical noise control.



Our global activities comprise individual control systems and air intake and cooling systems for gas turbines for industrial plants. We handle either the entire project or provide individual components for existing and new plants as well.

Your BBM Akustik sales consultants are skilled engineers, supported by our research & development department and quality assurance. Embedded in the powerful corporate network of the Müller-BBM Group, BBM Akustik is your reliable partner.

Intake systems

- In-house laboratory (ARAMCO)
- Own cooling technology
- Own filter technology



Noise control

- Project specific solutions
- Easy maintenance
- Acoustic expertise
- In-house acoustic laboratory



Research & Development

- Innovative
- In-house test facilities
- Scientific cooperations



Consulting

- Client-focused
- Qualified
- Reliable



Cooling systems for GT power plants



■ Why inlet air cooling?

Combustion turbines are mass flow engines. The output of the turbines is therefore dependent on the properties of the air flowing through the engines. As the inlet air temperature increases, its density and therefore the mass flow through the turbine decreases.

Inlet cooling will increase the mass flow through the turbine, increase the pressure ratio and reduce the work of compression. The result will be increased turbine output and reduced heat rate.

The system range of BBM Akustik covers traditional solutions with »Fogging« systems, which achieve a level of relative humidity of **up to 95%**. Fogging systems are always installed inside the intake duct immediately downstream of the filters to provide the maximum time for evaporation of water particles within the inlet duct.

Another solution offered is called »High-Fogging« or »Wet-Compression«. The water consisting of minute droplet, is injected directly into the bell-mouth of the compressor. With our High-Fogging system, BBM Akustik **exceed 100%** relative humidity, **over-saturating** the in-

let air which creates **intercooling** within the compressor and an additional power boost.

Due to an increasing market demand, BBM Akustik have developed a third system called »Up-Stream Fogging«. This solution provides a nozzle rack installation up-stream of the entire filter house. With this arrangement, BBM Akustik guarantees that no water will be injected inside the air intake. The Up-Stream Fogging solution of BBM Akustik achieves a level of relative humidity of **up to 93%** and is therefore more efficient than a traditional evaporative cooling system. BBM Akustik's fogging systems are fully automated and independent. They are available in a simple on/off version, controlled by a GT-control system or manually controlled by an operator.

The **Evaporative Cooling** system with the different pads is one of the easiest ways to decrease the inlet temperature. The functionality is based on air-flow through the humid evaporative pad. The water evaporates using kinetic energy taken from the air and the air will be chilled by using the water's large enthalpy of vaporization. De mineralized water is recommended.

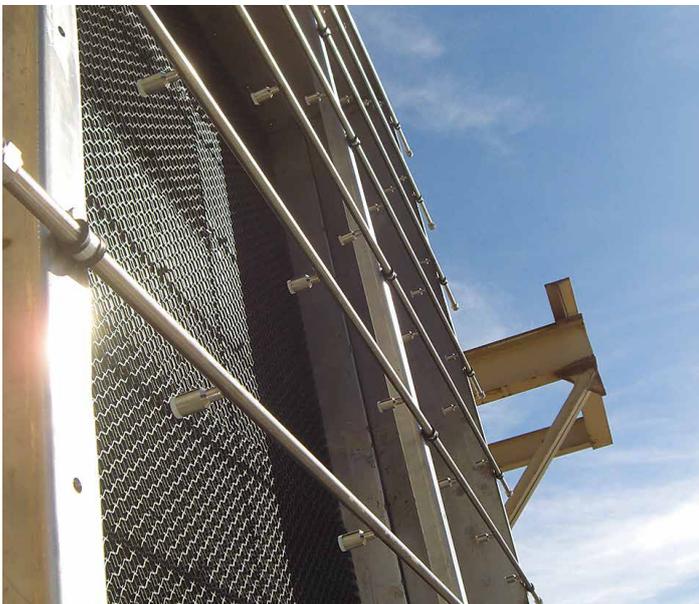
BBM Akustik Ceramic Nozzle

Since its emergence in the mid 1990's, Inlet Fogging has seen a significant growth in development and application. It is now widely accepted as one of the most cost effective forms of gas turbine power augmentation, providing continuous power boosts up to 25%.

Following its discovery (during a series of on-line compressor water wash tests) fogging technology has advanced considerably and been utilised worldwide to improve gas turbine performance. This has only been made possible by the extensive research and development carried out to forge improvements in the field. BBM Akustik have made a number of breakthroughs in fogging system design and techniques as a result of our ongoing research and development programme in collaboration with turbine manufacturers and the Aargau University of Applied Sciences.

BBM Akustik has focused on the quality of atomized water particles and their effect on evaporation and turbine operational safety. Studies have shown that water droplets with a characteristic diameter in the range of 20 microns tend to follow the air stream and consequently avoid impingement on the compressor blades.

The BBM Akustik fogging system is the first of its kind designed expressly for the power generation market. BBM Akustik have employed materials technology, laboratory and field testing to develop a new generation nozzle arrangement that produces a homogenous water droplet spectrum of less than 20 microns.



■ Why inlet fogging?

Inlet fogging provides numerous advantages over alternative types of cooling:

- Nearly 100% adiabatic cooling up to 1% power increase for every 1 °C temp. decrease
- Fog inter-cooling possible – 5% power increase for 1% increase in mass flow
- Negligible pressure drop
- Low investment
- Minimal downtime for installation
- Easy retrofit installation – no structural modification to filter house
- Minimal parasitic load
- Fast ROI



■ Patented solution

The patented **Multihead Swirl Pressure Nozzle** is comprised of a number of slim radial nozzle arms, distributed evenly around a central boss. Each radial nozzle arm is fitted with BBM Akustik's patented ceramic nozzle.

Each nozzle casing contains ceramic inserts with a conical recess. Tangential water inlets initiate a swirl within the cone as the water is driven toward the nozzle aperture, exiting the nozzle as a high velocity tornado of extremely fine droplets.

The quality of the nozzle spray has been demonstrated in a number of laboratory tests. Droplet spectra have been analysed under realistic operation conditions and nozzle lifetime has been assessed by long term endurance testing. The service life of the ceramic nozzle is more than 15,000 operating hours, whereas steel nozzles last only half as long.

The evolution in fogging technology resulted in the development of the FOG Multihead Swirl Pressure Nozzle. A system that exhibits highly reproducible accuracy and a long service life without loss of performance.

Cooling



■ UpStream Cooling System [UpS]

This system is perfect for retrofit installations. Usually there is not enough room in the existing air intake to install an adequate and efficient cooling system afterwards. Filter house modifications are expensive and result in a long downtime of the GT. Or modifications are in all prohibited due to warranty contracts.

The UpStream Cooling system is installed outside the air intake in front of the weather hoods. The system can be installed and maintained from the outside without disturbing the GT operation. No water treatment on site is needed.

No risks of water or other foreign objects inside the air intake that may damage the compressor. No demineralized water needed. The UpS system mesh will additionally filter the air from large particles for an air washing effect and longer air filter lifetime. Rapid and simple installation and maintenance.

Features

- Adiabatic cooling: > 93% efficiency
- Wide range of water quality can be used
- Additional air washing effect
- No water inside air intake
- Easy retrofit solutions
- No GT shutdown required for installation

Technical details

- Power gain: 0.6 – 1% per 1 °C of cooling
- Differential pressure loss < 50 Pa
- Low power consumption
- Guaranteed dry air intake
- Installed upstream of filter house



■ Evaporative Cooling System [EVAP]

This system is commonly installed after the first air filter stage. Water is distributed over a special media/pad with a very large surface. The air is lead through the pads where it cools down adiabatically.

Demineralized water is recommended but is not mandatory depending on the pad material and site conditions.

Features

- Adiabatic cooling: > 90% efficiency
- Wide range of water quality can be used
- Simple cooling technology

Technical details

- Power gain: 0.6 – 1% per 1 °C of cooling
- Differential pressure loss < 75 Pa
- Negligible power consumption
- Installed down- or upstream of air filters



■ High Fogging System [HFOG]

This system sprays the water directly before the compressor. Therefore the majority of the fine water spray will enter the compressor and evaporate there. This is also called »Compressor Inlet Cooling« or »Wet Compression«.

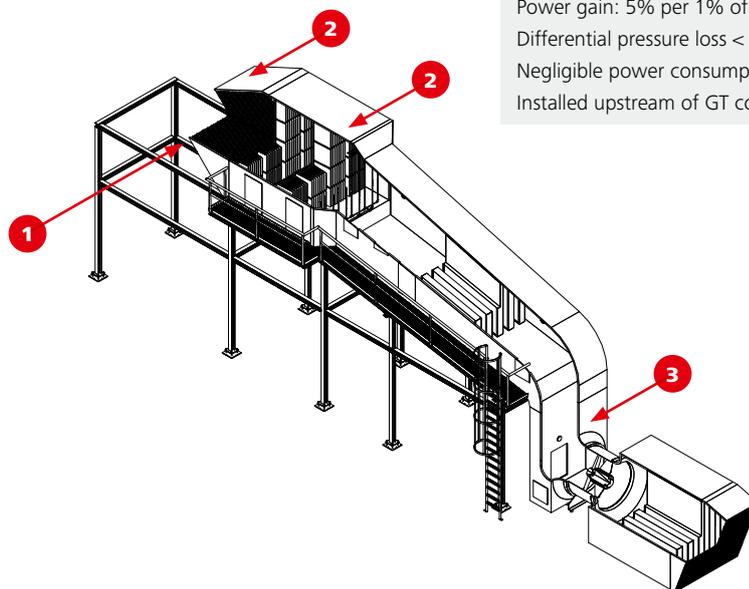
The advantage of this system is to give the GT an additional power boost whenever needed, without being dependent on ambient conditions. Even in tropical regions with high humidity you can get a significant power increase.

Features

- Wet compression up to 2% water flow
- All droplets evaporate inside the compressor
- Not dependent on ambient weather conditions
- NOx reduction
- AxE Nozzles match GT outage intervals

Technical details

- Power gain: 5% per 1% of water flow
- Differential pressure loss < 100 Pa
- Negligible power consumption
- Installed upstream of GT compressor



Solving industrial noise problems for more than 50 years.

BBM Akustik Technologie – a leading supplier of industrial silencers, enclosures, exhaust systems and air intake systems

EN ISO 9001 certified

Our products

Air intake systems

- Full-scale air intake systems
- Multi-stage static filter systems
- Self-cleaning pulse filter systems



Flue-gas silencers

- Bypass silencers
- Gas turbine silencers
- HRSG ducts



Steam silencers

- Vent silencers
- Start-up silencers
- Blow-off silencers



Acoustic enclosures and claddings

- Facades and shrouds
- Partial HRSG enclosures
- Steam and gas turbine enclosures



Exhaust systems

- Exhaust ducts
- Silencers and stacks
- Retrofits



Engine exhaust silencers

- Intake and exhaust flow silencers
- For diesel and gas engines
- DNV certified spark arrestor



Condensate systems

- Complete system design
- Condensate tanks and flash tanks
- Piping and blow-off silencers



Cooling tower silencers

- Natural draught cooling towers
- Forced air cooling towers
- Cell cooling towers



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