

# Gas Turbine Compressor Cleaning Systems & Chemicals for all types of gas turbines

An average 46,500kW gas turbine with normal fouling and showing a 3% power decrease and 1% heat rate increase can suffer a loss of performance costing more than \$500,000 every year.

Understanding our customers' need to keep their engines operational at the highest possible output and lowest possible cost Rochem Technical Services offers a range of On-crank (crankwash) and On-line (Fired Wash) engine cleaning systems and chemicals.

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## HOW DO COMPRESSORS FOUL?

In spite of the highly sophisticated air cleaning systems available today, ingress of air borne particles into the gas turbine compressor is inevitable. As a result, fouling of air-path surfaces in the turbine compressor occurs, leading to performance loss and increased fuel consumption. Worldwide field experience has clearly demonstrated that axial flow compressor deterioration during operation accounts for the major portion of gas turbine related performance loss from the new and clean condition. Of the total gas turbine performance loss approximately 70% can usually be attributed to compressor deterioration due to blade fouling. Fouling of axial flow compressor blades is generally attributed to airborne particulate in the sub-micron to 10 micron size range and this will be the major source of fouling. Another possible source of compressor fouling is oil leakage from the compressor rotor inlet bearing.

## WHY DOES THIS FOULING AFFECT MY ENGINES' PERFORMANCE?



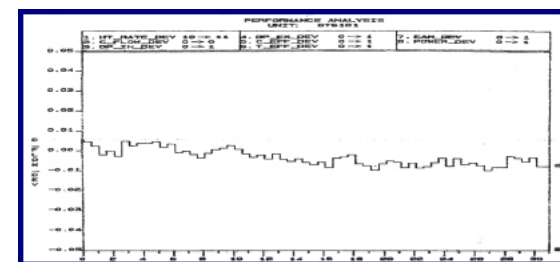
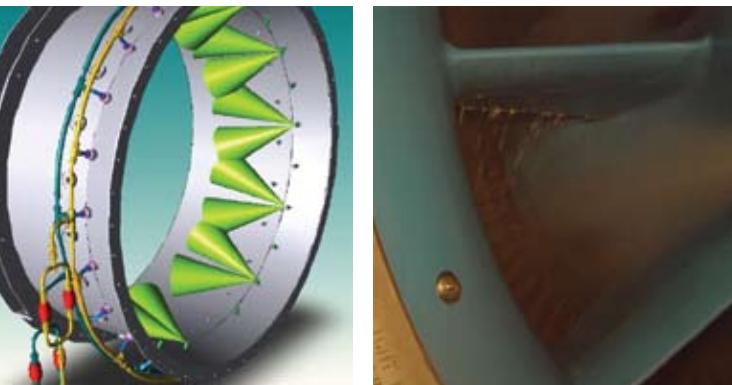
Axial flow compressor blading comprises smooth airfoil shapes similar to an airplane wing and consequently blade performance may deteriorate due to increases in surface roughness or due to shape changes brought about by blade deposits. Blade deposits or fouling, of the type shown reduces both compressor airflow and efficiency that combine to reduce gas turbine output and overall thermal efficiency. In addition the compressor discharge pressure drops due to the reduced air mass flow rate through the turbine nozzle. Fouling will therefore be recognised by a drop in turbine output for a given exhaust gas temperature, accompanied by a lower compressor discharge pressure. These effects will be accompanied by an increase in heat rate, resulting in increased fuel consumption.

## HOW DO YOU CLEAN YOUR COMPRESSOR?

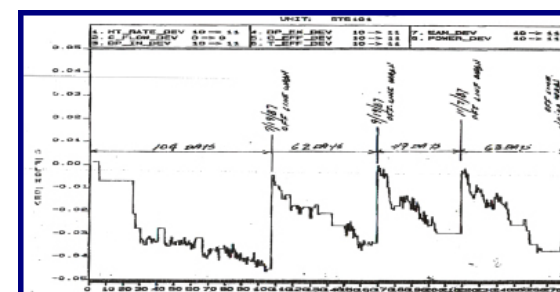
- X HAND CLEAN** – time consuming and labour intensive, high loss of revenue due to shutdown.
- X ABRASIVE CLEANING** – crushed walnut shells, or similar, are ingested into the air inlet whilst the engine is running. Contaminants are removed by 'shot blasting', performance is often short lived and potential damage to surface coatings and cooling path blockages may result leading to permanent performance loss.
- ✓ WET CLEANING** – the most effective and least damaging is to perform a strict washing regime combining on-line and off-line washing using **FYREWASH®** chemicals and treated water.

**On-line cleaning** is performed with the engine running on load, a wash solution is injected into the air inlet using specially designed nozzles to ensure comprehensive wetting of the compressor blades and effective cleaning through the compressor stages.

**Off-line cleaning** is performed with the engine shutdown and cranking, a wash solution is injected into the air inlet using specially designed nozzles to ensure comprehensive wetting of the compressor blades and effective cleaning through the compressor stages. A post rinse, using treated water, cycle ensures that all of the removed fouling is removed from within the compressor prior to start-up.



ENGINE PERFORMANCE GRAPH – BETWEEN ONLINE WASHES



ENGINE PERFORMANCE GRAPH – REGULAR ONLINE WASHING





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### FYREWASH® CHEMICALS


A range of specialist compressor cleaning chemicals with outstanding performance designed for all types of fouling and meeting current OEM and environmental standards world-wide. All of the Rochem FYREWASH® chemical range is suitable for both on-line and off-line washing. They are mixed with treated water in a ratio of 4:1.


 **FYREWASH® SB** was the first heavy-duty hydrocarbon solvent-based chemical to be developed specifically for on-line, fired washes cleaning of gas turbine compressors. And after more than 25 years of use throughout the world and tens of millions of engine operating hours SB still remains in production because it is still a very popular and effective on-line compressor cleaner.

 **FYREWASH® F1** is the successor to FYREWASH® SB, the first hydrocarbon solvent-based chemical ever to be created especially for on-line, fired wash cleaning of industrial, marine or aviation gas turbine compressor. FYREWASH® F1 still retains all the cleaning power of SB to deal with even the heaviest oil and carbon-based compressor fouling. However, new manufacturing processes make FYREWASH® F1 the purest, most user friendly, low metals product of its kind on the market.

 **FYREWASH® F2** is a powerful yet highly biodegradable water-based natural solvent cleaner. Since other so-called 'water-based' chemicals generally contain no solvents, only surfactants, such chemicals have less ability to dissolve and remove the oily and carbonaceous deposits, which typify gas turbine compressor fouling. And that's the crucial difference between FYREWASH® F2 and other water-based chemicals. F2 really works because it is a highly active, yet biologically soft, water-based solvent/surfactant cleaner which is capable of dissolving and removing oily/carbonaceous compressor deposits which other non-solvent water-based surfactant chemicals would not be effective against. The pine oil solvent and the ultra pure surfactants in the FYREWASH® F2 formula make it an environmentally safe and user-friendly product for both on-line and off-line compressor cleaning. F2 is also a perfect substitute for those operators who might prefer a water-based product but find that plain water-based, non-solvent cleaners do not perform well for them.



 **FYREWASH® F3** was developed to give the maximum possible cleaning efficiency and effectiveness from a non-solvent chemical. When developing and testing FYREWASH® F3, Rochem's chemists evaluated all other leading non-solvent water-based chemicals to make sure that F3 would have superior cleaning qualities. This resulted in a non-hazardous, user-friendly and highly biodegradable water-based cleaner which now sets the standard against which the performance and cost effectiveness of all other true non-solvent water-based gas turbine compressor cleaners can be judged.

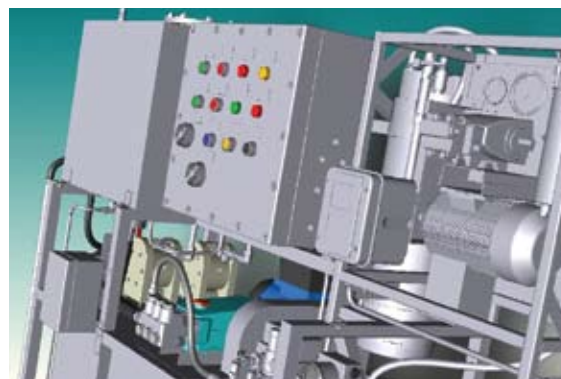
 **FYREWASH® F3-RR** is a pure biodegradable water-based detergent which is approved by Rolls Royce (RR) for the on-line and off-line cleaning of its gas turbine compressors. FYREWASH® F3-RR was specially formulated by Rochem to meet the very stringent quality and cleaning requirements of RR. It is also a true non-solvent, water based chemical which is non-hazardous, user friendly, readily biodegradable and very effective in the removal of compressor foulants.

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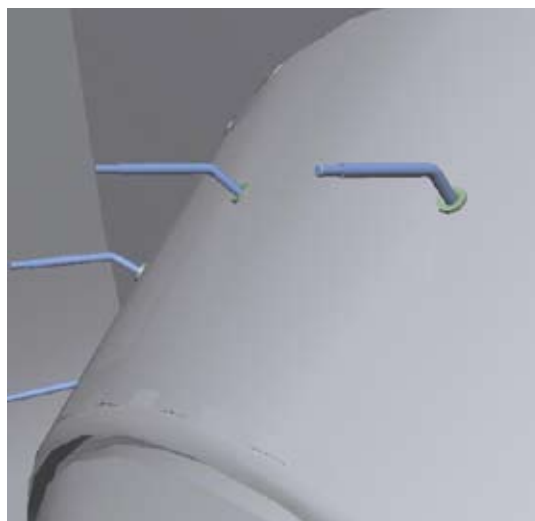


### WHAT EQUIPMENT DO I NEED?

Rochem design and manufacture specialist nozzles producing optimum droplet size distribution and wetting of the compressor inlet to provide effective cleaning of the compressor blades while eliminating potential blade surface erosion. Injection flow rates are optimised as to not degrade the machine by over wetting. Computational Fluid Dynamics and 3-D modelling techniques are used together with field testing to continually develop and improve our system efficiency.



Rochem wash delivery systems are designed for ease of use, minimum maintenance providing control of fluid delivery to the on-line and off-line nozzles.



Rochem products have the following benefits:

- Proven track record, over 30 years in business
- In excess of 8000 systems installed world-wide on every type of gas turbine
- Full range of specialist chemical products to meet all types of compressor fouling
- Supplier to OEM's for new equipment and end users for retrofit application
- Strategic stock of FYREWASH® chemical products held world-wide and distributed via our world-wide business network
- Full product support by our own industry expert team
- Equipment and FYREWASH® chemicals are designed and manufactured in-house by Rochem
- FYREWASH® Chemicals have extensive OEM approvals
- Manufacturing to ISO9001:2008 and ISO14001



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Rochem is an approved  
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