Maintaining your Compressor in demanding environments

Image by POA (Phot) Sean Clee

ZOK
Shaping the future of gas turbine washing

Date
ZOK brings over 30 years experience of delivering long term commercial and environmental benefits to our worldwide customer base via our dedicated global distribution network. An active Research & Development program ensures ZOK’s future as a global leader in the production & distribution of environmentally responsible Gas Turbine Compressor Cleaning Solutions, providing our customers with a competitive advantage in their markets.
What contaminates an engine

- Engines operating in harsh environments are hugely affected by contaminants being ingested. These contaminants can be:
  - Particulate-sand-soil & salt
  - Hydrocarbons-oil & fuel
  - Usually airborne
Why wash an engine at all?

Regular washing with a good quality approved water based cleaning solution will:

• Remove deposited contaminants - restoring aerodynamics & compressor efficiency - helping to ensure:

• Maximum available power output

• Improve fuel efficiency

• Reduce hot section component deterioration
Compressor washing - Keep your compressor happy

- Single most misunderstood process in gas turbine compressor maintenance
- Yet single most cost effective maintenance activity you can carry out

Turbines can lose 10% or more of their operating efficiency if not kept clean
At this stage the penalty is loss of optimum blade profile and extra fuel used to maintain output
Compressor washing - Keep your compressor happy

- If left alone unnecessary engine removals will occur
- Hot section deterioration will render components as scrap when removed from the engine - not repairable
Why choose a water based wash solution?

- RAF helped develop unique formulation of water based corrosion inhibiting compressor cleaning solution
  - Hostile operating conditions

- Why?
  - To enable flight at a moments notice

- Enabled quick flight turn around and engine protection

- Wash every 25hrs engine run time

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Using water based detergent to wash

- Eco-Friendly
- Aqueous NOT Solvent based cleaners
- Solvent based cleaners eventually harden internal seals
- Solvent based cleaners - difficult to safely/environmentally dispose of
- Unique formulated Surfactant - for increased penetration and removal of fouling
- Wide range of approvals
Why are these benefits?

- No need to rinse water based cleaning agent from engines
- Good cleaning efficiency - Fewer washes needed
- Low Ash - Fantastic for online washing
- Reduction in metal flake formation
  - Less corrosion of blades
- Surfactant very stable in all conditions
  - No need for agitation

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Obtaining approvals

To obtain approvals from OEMs the cleaning solutions need to comply with a significant number of stringent tests performed at Internationally recognised Labs

For Example - SMI (Scientific Material International)

- Ash <0.01%
- Some metal elements <0.1ppm for Online washing

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Obtaining approvals

The margin for error is minute hence testing performed in-house to every batch to ensure only the highest quality products leave the factory

ZOK GOLD is approved by Siemens Germany and Rolls-Royce

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Approvals

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ZOK
Manufacturers of water based biodegradable cleaners for all GAS TURBINE COMPRESSORS
Approved by all major OEMs including:
- ALSTOM
- Solar Turbines
- SIEMENS
- Pratt & Whitney
- Mitsubishi
- Kawasaki
- GE

Accredited to:
9001, 14001, 18001
Compiles with:
Achilles, Cefas, HOCNF

zok.com

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

MINISTRY OF DEFENCE
Gas compressor washing working for Power Stations

- Wash procedures performed on an Indonesian Power station

- Wash and rinse samples analysed for information regarding:
  - Types of contaminant
  - Quantities of contaminants
  - Leading to a recommendation for the most effective wash duration and dilution ratio

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The Results

- Off-line washing removes particulate matter and “sticky” coating on blades
- On-line washing removes particulate matter
- Rinse samples still contained traces of contaminants but at significantly reduced levels compared to the wash fluids
- Successful - as we can now quantify what washing achieves
Concentration of contaminants within samples taken during an off line wash.

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Waste matter identified in wash samples

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GT Wash Case Study

- Washing performed on three Siemens engines at a UK Power Station

- Before Washing started:
  - Unplanned shut downs every 4-6 weeks
  - Unacceptable range of engine temperatures

- Unplanned shut downs due to loss of engine performance

- Not washing with a detergent so engine not being cleaned well enough
Exhaust Temperatures Before Washing

Block 1 Burner Spread

Burner 1, Burner 3, Burner 5, Burner 7, Burner 9, Burner 11, Burner 13, Burner 15, Burner 17, Burner 19, Burner 21, Burner 23

08-Apr-11 10:50:00
08-Apr-11 11:05:00
08-Apr-11 11:20:00
08-Apr-11 11:35:00

510-560, 560-610, 610-660, 660-670

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Exhaust Temperatures After Washing

Block 1 Burner Spread

Burner 1, Burner 3, Burner 5, Burner 7, Burner 9, Burner 11, Burner 13, Burner 15, Burner 17, Burner 19, Burner 21, Burner 23

09-Jun-11 08:18:00
09-Jun-11 08:33:00
09-Jun-11 08:48:00
09-Jun-11 09:03:00

510-560 560-610 610-660 660-670

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ZOK GOLD Trial

- Originally washing with demineralised water
  - Now running a range of dilutions to find optimum cleaning point
- Both wash and rinse samples sent back to ZOK for analysis

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GOLD Standard Results

• Initially one turbine was to be left to compare the cleaning results - Results so good all engines cleaned!

• Engine temperatures much more consistent

• Early stages of the study suggests that we are experiencing improved engine efficiency and availability

• Major inspection later this year will show just how clean ZOK GOLD makes an engine!
Testing of ZOK GOLD in the field (ongoing)

- ZOK GOLD under test at a Power Station in the UK has experienced the following results:
  - Reduced NOx levels from 57.3mg/Nm³ to 41.4 mg/Nm³
  - Increase of compressor efficiency
  - Heat rate has decreased since washing with a detergent
Why manufacture ZOK GOLD?

- ZOK GOLD was formulated to comply with the Oslo and Paris Commission
- To comply with the stringent requirements of OSPAR
- OSPAR regulates for the prevention of pollution in the North East Atlantic
### OSPAR Classification

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Accreditations and testing

- Tested against Rolls-Royce and G.E. specification.
- Products conform to both sets of specifications.
- **ZOK GOLD** is accredited by Rolls-Royce for use in their engines.
- Currently seeking accreditation from Siemens & G.E.
In-house Testing

- Batch testing
- ICP and IR analysis of final product
- QC techniques to ensure that the fluids dispatched will always meet OEM criteria

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ZOK GOLD

- ZOK GOLD - is the next generation cleaner
  - Biodegradable
  - Eco-Friendly
  - Low marine toxicity

- ZOK GOLD uses a renewable source of surfactant
  - New surfactant = an improved cleaner
New Surfactant

• The development of ZOK GOLD hinged on the formulation of a new generation of surfactant

Producing:

• Improved biodegradability
• Eco-friendly 27 & mx solutions
• New surfactant tested and found to be a better cleaner than previous solutions

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Future Developments

- Development of surfactant technology including:
  - Improved cleaning
  - Environmental Profile
  - Alternative sources of renewable surfactants

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Conclusion

- Don’t let your GT become a financial ‘black hole’
- Remember the Things you can do to keep your GT happy
- Compressor washing keeps you on top of your game
- Water based cleaners are non-toxic
- GOLD field trials demonstrate excellent cleaning record
- ZOK has the facility to analyse your wash samples - benefit to you
- Custom washing schedules provides maximum return on investment
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Any Questions?