



Company Presentation

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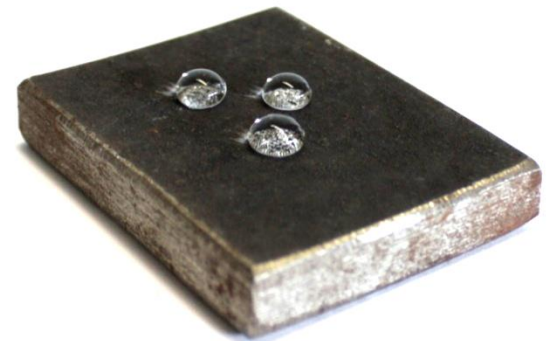
- Over 30 years of expertise in development and application for chemical water treatment in:
 - Power plants
 - District heating networks
 - Cooling circuits
- Economical and ecological proceedings for cleaning, preservation and operation of water- and steam cycles
- Innovative technologies and product solutions, self developed and produced product ODACON®
- Individual support service with skilled service engineers and own laboratory

Scope of Service

	Steam and hot water boilers	Industrial cooling circuits	Engine cooling circuits
Chemical cleaning	<p>chemical cleaning</p> <ul style="list-style-type: none"> To remove iron oxide and carbonate layers <p>boiling and blow-out</p> <ul style="list-style-type: none"> To reduce the initial contamination effective corrosion protection up to commissioning 	<p>chemical cleaning</p> <ul style="list-style-type: none"> To remove iron oxide and carbonate layers <p>disinfection</p> <ul style="list-style-type: none"> To remove organic deposits 	<p>chemical cleaning</p> <ul style="list-style-type: none"> To remove iron oxide and carbonate layers <p>disinfection</p> <ul style="list-style-type: none"> To remove organic deposits <p>oil removal</p> <ul style="list-style-type: none"> E.g. after leakage of heat exchanger
conditioning	<p>ODACON®</p> <ul style="list-style-type: none"> Protection of the complete water and steam system <p>Online cleaning</p> <ul style="list-style-type: none"> Remove deposits during operation <p>service</p> <ul style="list-style-type: none"> Water analytics on site and in own laboratory 	<p>service</p> <ul style="list-style-type: none"> Water analytics on site and in own laboratory Control of biological contamination / legionella control <p>Chemical treatment</p> <ul style="list-style-type: none"> Biocides, pH-value control, hardness stabilisation Cooling water with and without antifreeze components 	<p>service</p> <ul style="list-style-type: none"> Water analytics on site and in own laboratory Control of biological contamination / legionella control <p>Chemical treatment</p> <ul style="list-style-type: none"> Biocides, pH-value control, hardness stabilisation Cooling water with and without antifreeze components
preservation	<ul style="list-style-type: none"> Before standstill periods Formation of a stable, hydrophobic protection layer high protective effect in the filled and (partially) emptied state. <p>objective:</p> <ul style="list-style-type: none"> No corrosion during standstill period Protection of steam generator and turbine during re-commissioning 		

ODACON®

Effects and Effectiveness



General characteristics of ODACON®

- ODACON® is a pure and stable watery emulsion of Octadecylamine (ODA)
- the emulsion contains no admixture of phosphate, Hydrazine, other (poly-) amines or emulsifiers
- REICON guarantees the chemical purity of the emulsion as follows:

Chloride	< 2 ppm
Fluoride	< 2 ppm
Sulfate	< 2 ppm

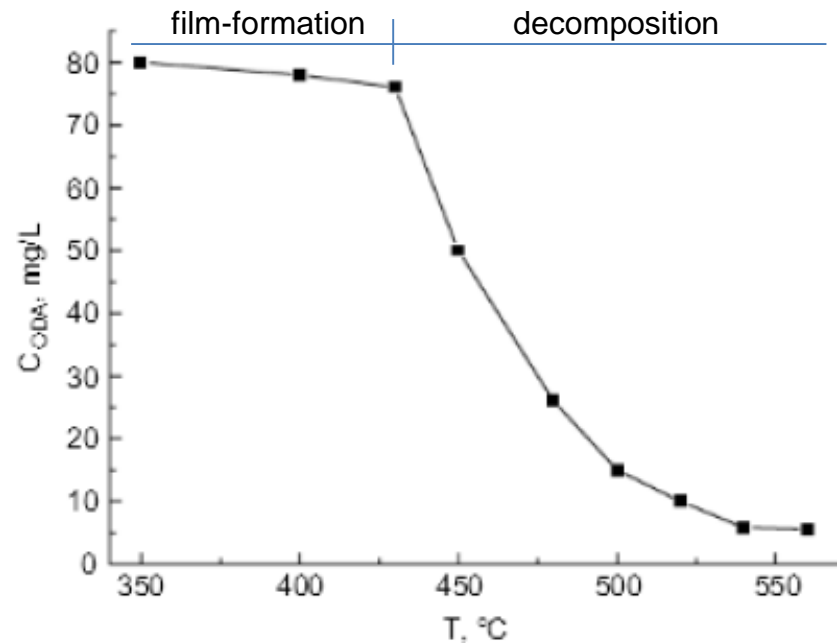
Silikate	< 0,5 ppm
Acetate	< 1 ppm
Natrium	< 1 ppm

- ODACON® is a biodegradable, non-toxic product

biodegradability	81 % in 28 days
Nitrogen	0,06 ppm*
BSB₅	0,98 ppm*
CSB	1,85 ppm*
TOC	0,39 ppm*

**Valid for an ODA concentration of 1 ppm (Dr. Roth bioTEST 1995)*

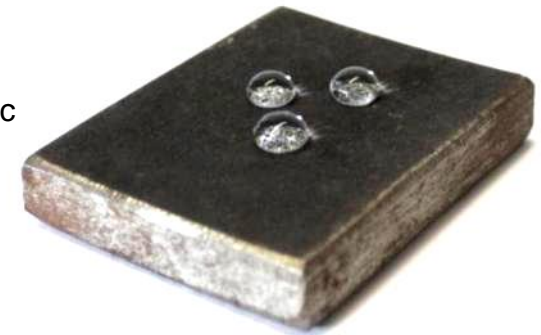
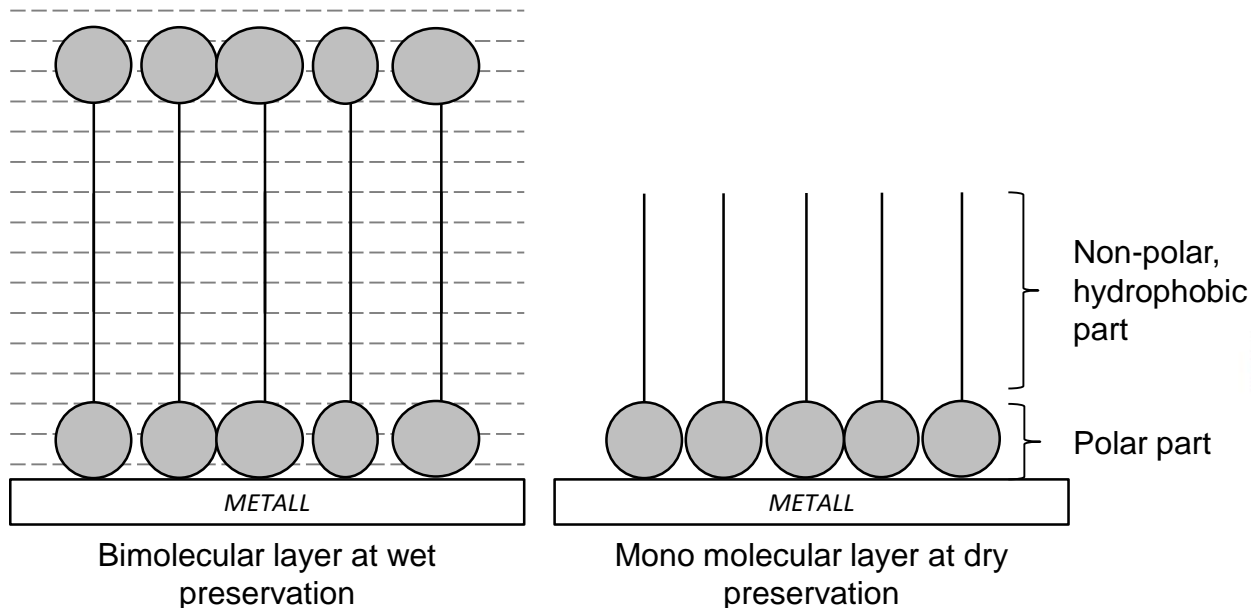
- No thermal decomposition up to 450°C
- Decomposition equilibrium at 520°C
- Decomposition products contain **no harmful organic substances** such as low molecular organic acids
- Results are gained in a autoclave test under static conditions



Relationship between ODA concentration and temperature

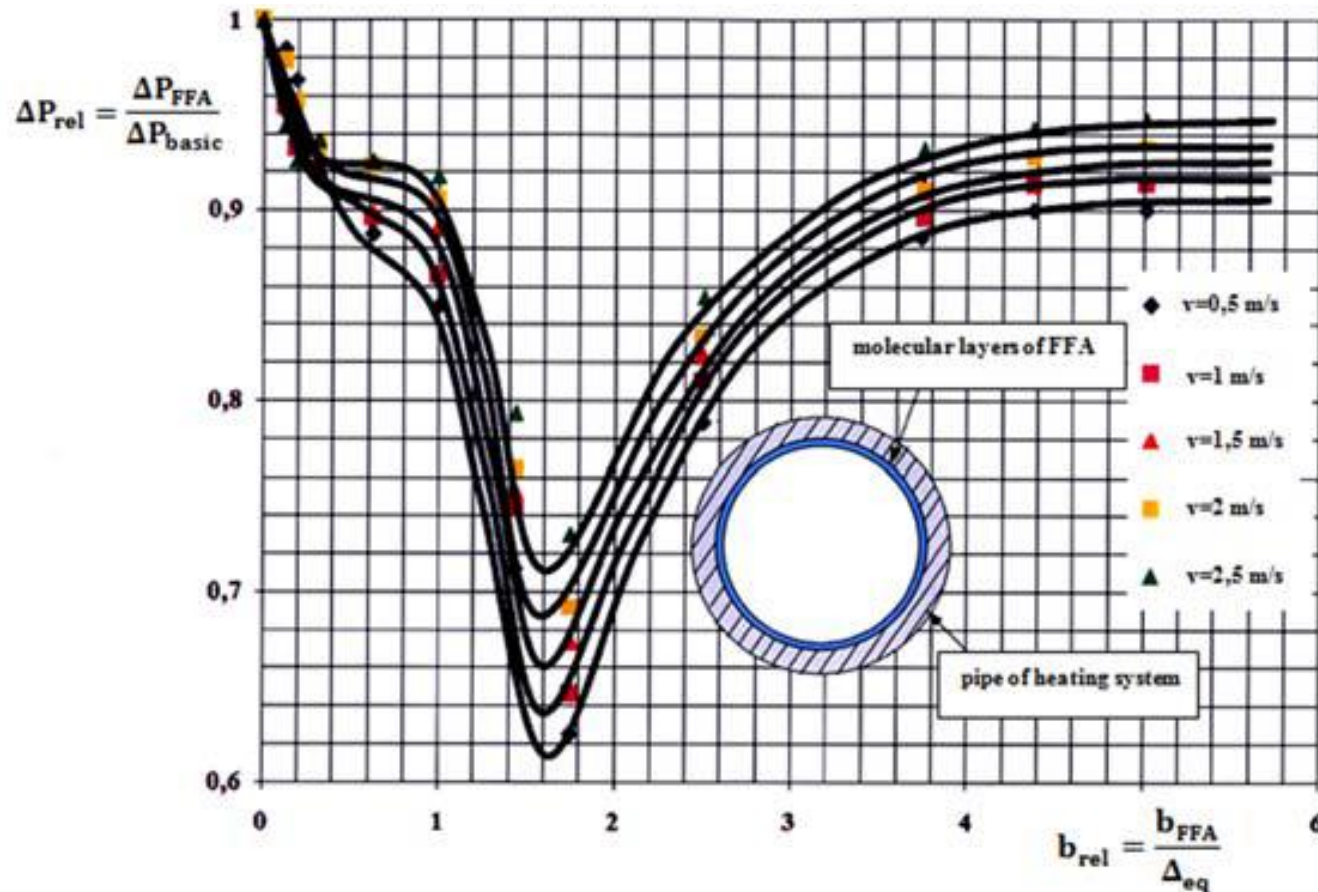
source: Cao, S., Hu, J., Xie, J., Liang, Q., Yin, L., "Research on the film-forming characteristics of octadecylamine at high temperatures", Anti Corrosion Methods and Materials, Vol. 60 No. 1 2013, pp. 14 - 19

- formation of mono or bimolecular protection layers by
 - 1. Physisorption between metal surface and polar part
 - 2. Chemisorption and ion bonding
- strong and durable connection of ODA molecules at the surface leads to a long term preservation effect

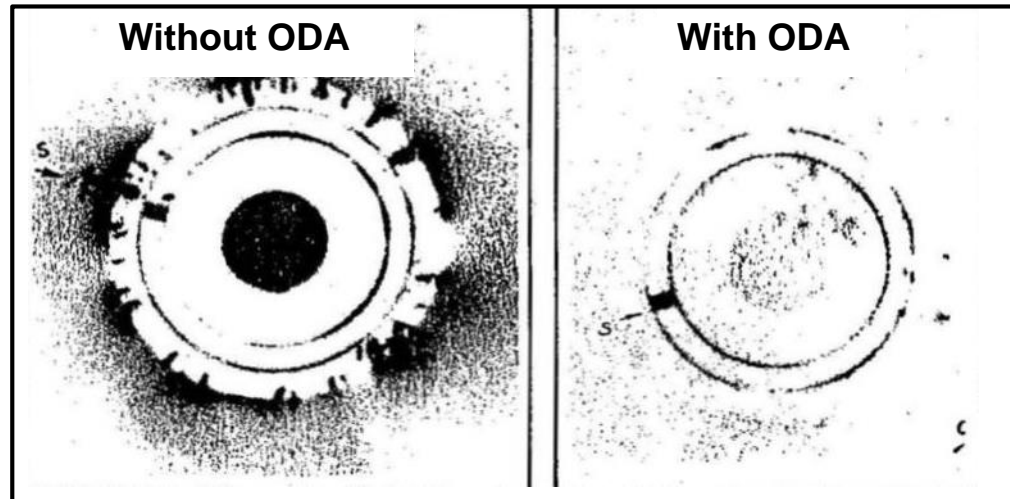


Changing of flow conditions by ODA

- reduction of the surfaces' relative roughness due to formation of mono- or bi-molecular amine layers
- significant improvements in terms of hydrodynamic characteristics
- reduction of the hydraulic resistance of pipelines



- ODACON® has a mobilizing effect on oxides and corrosion active deposits
- these deposits are gradually and carefully removed
- chloride or similar harmful substances are displaced during adsorption

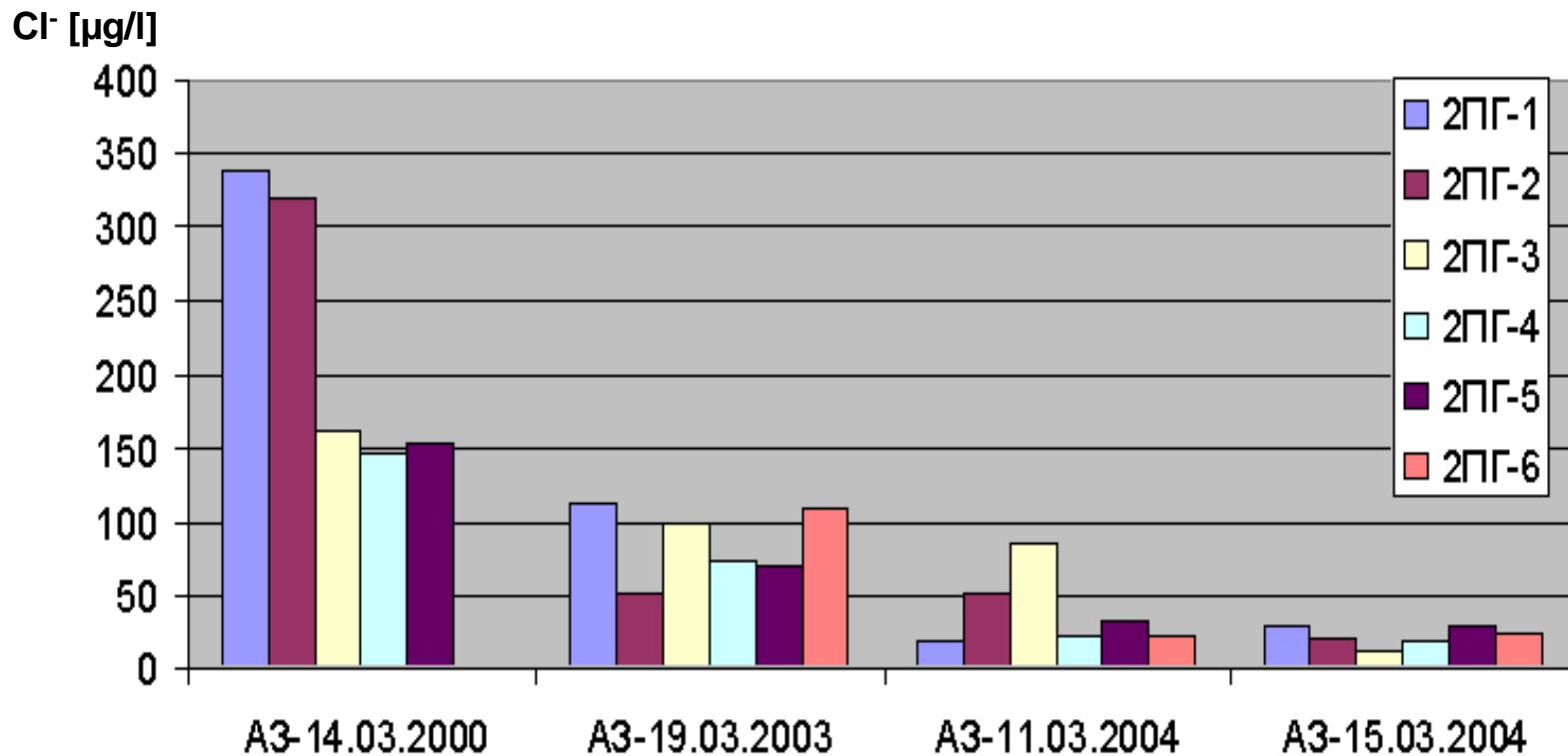


autoradiograph of clamped samples
(density level = rate of chloride accumulation)

- Protection against stress crack corrosion even in crevices

Mobilizing effect of ODACON® - Example

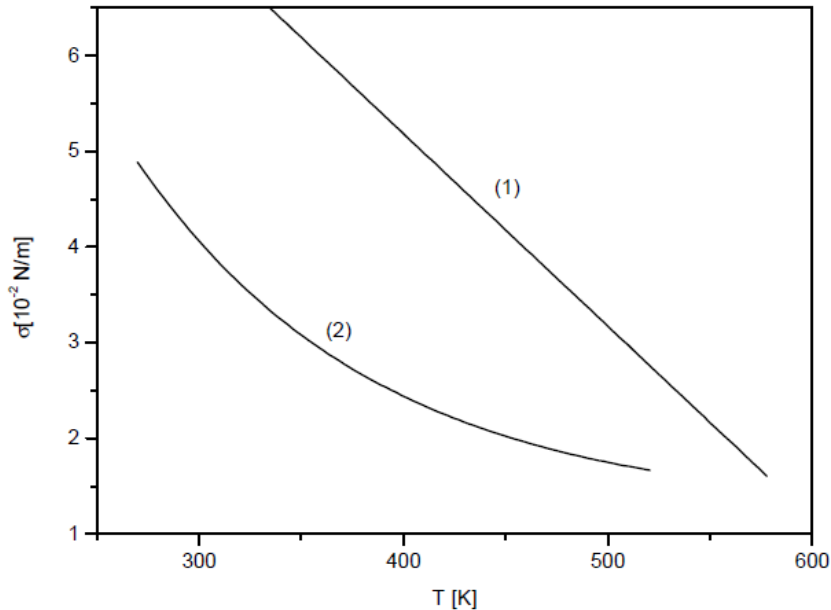
- Cleaning effect on heat transfer surfaces of the steam generator from corrosion products (from 200 g/m² to 120 g/m²) and salts e.g. Chloride



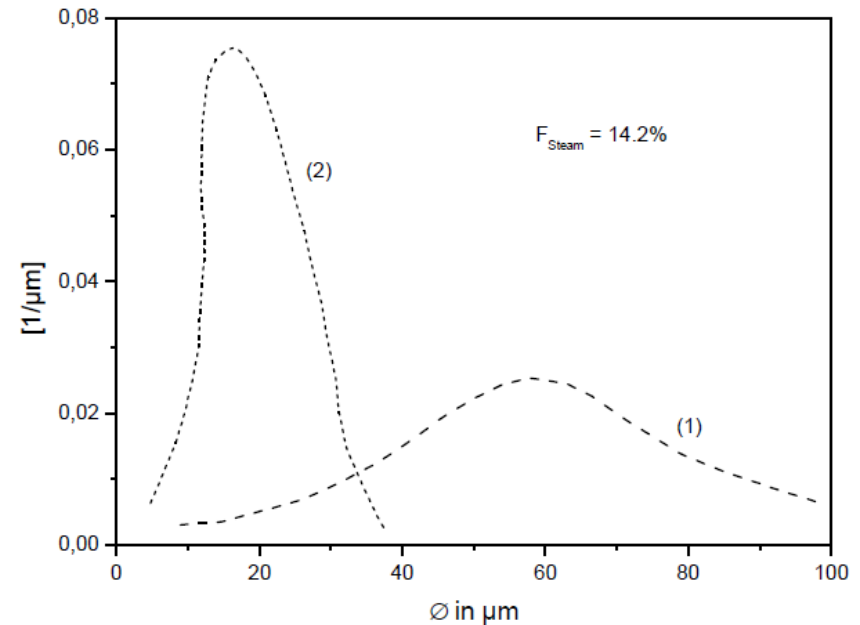
comparison of blow down water at unit 2 of NPP Kola (VVER design)

Decrease of surface tension

- ODACON[®] is lowering the surface tension of water whereby the droplet diameter is scaling down strongly



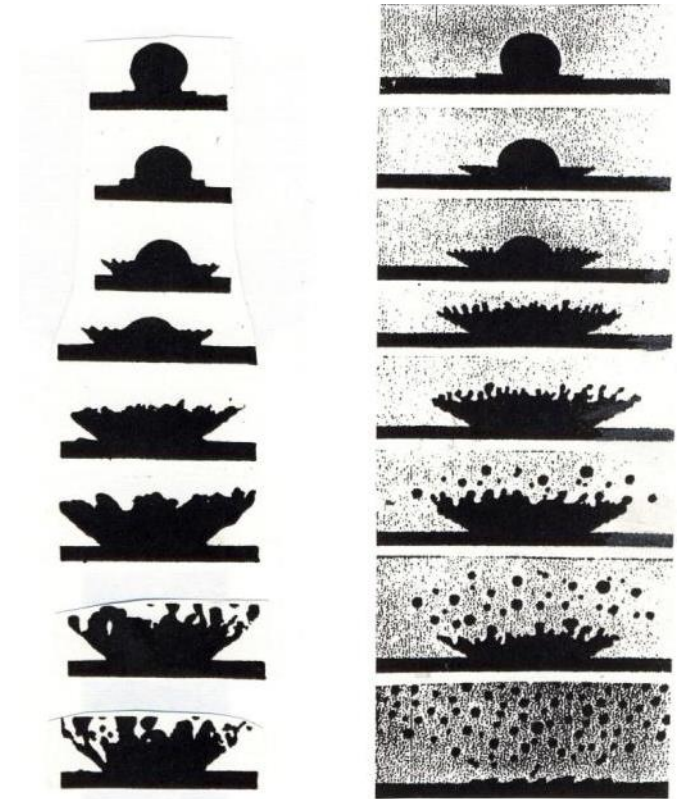
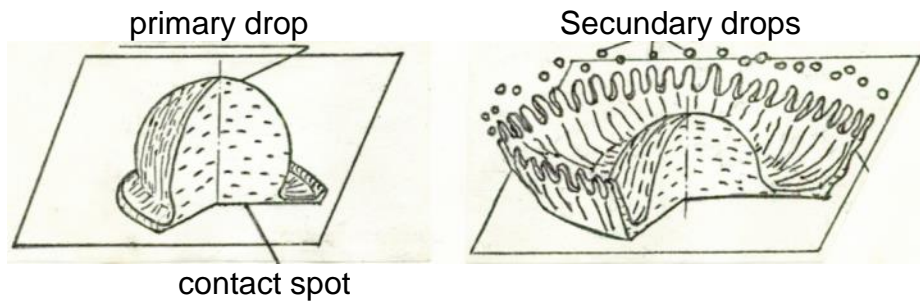
T dependence of the surface tension of pure water (1) and saturated ODA solution (2)



Distribution of the droplet size, curve (1) without ODA and curve (2) with ODA

Impact on droplet characteristic

- Improvement of wettability
- Faster diffusion of droplets
- Reduction of the maximum force on the surface during impact
- Films at the rear edge of turbine blades will be sprayed into small droplets



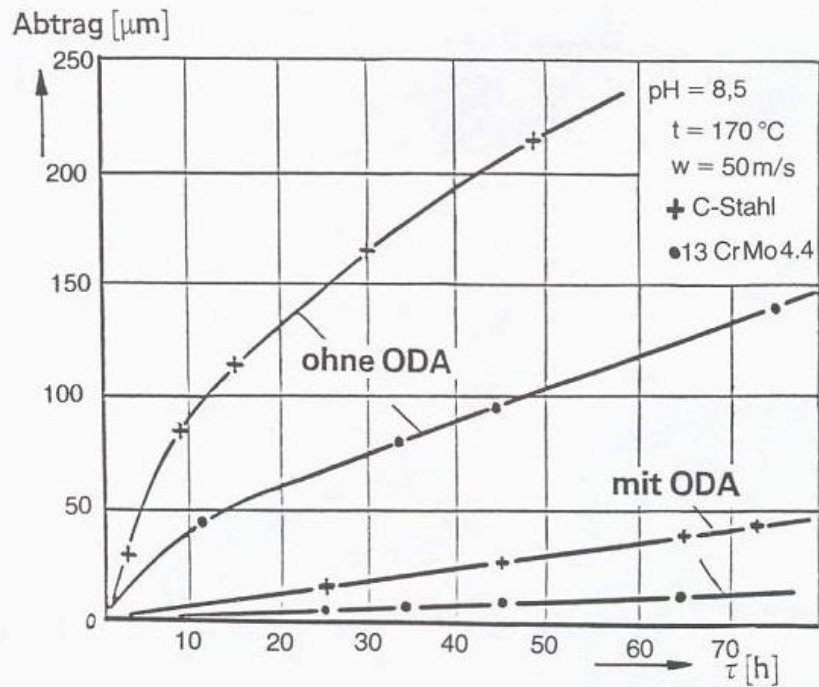
Without ODAICON

with ODAICON

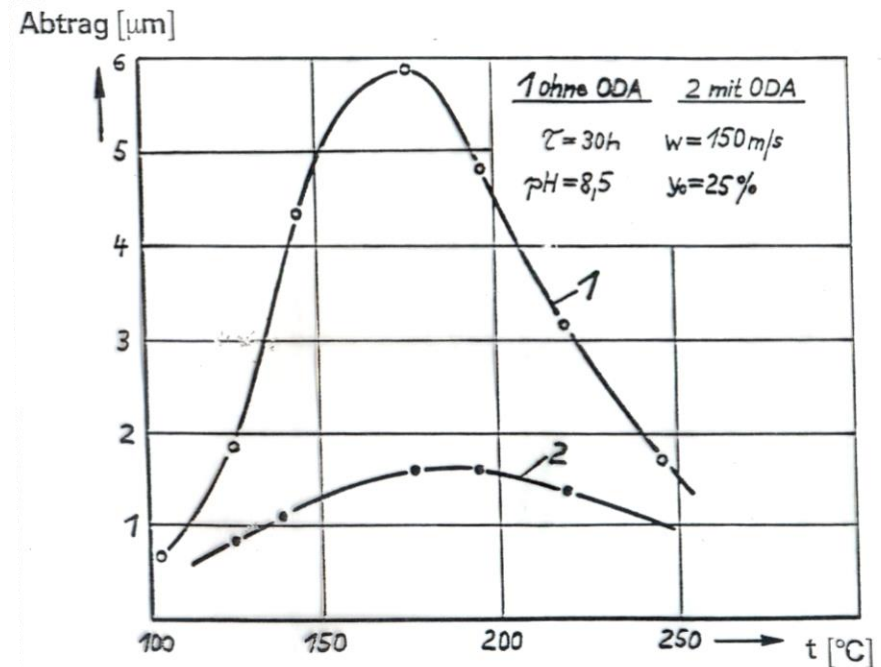
slow motion of drop impact on a solid surface

Influence to abrasion through erosion

- Forming stable protective layers in steam and condensate system
- Decrease of material removal through erosion
- Protection against stress crack corrosion and corrosion fatigue

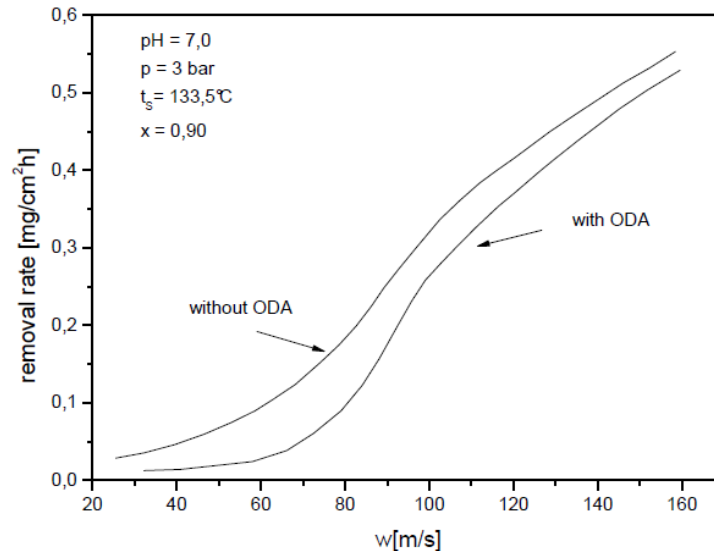


abrasion through erosion at different sorts of steel as a function of time

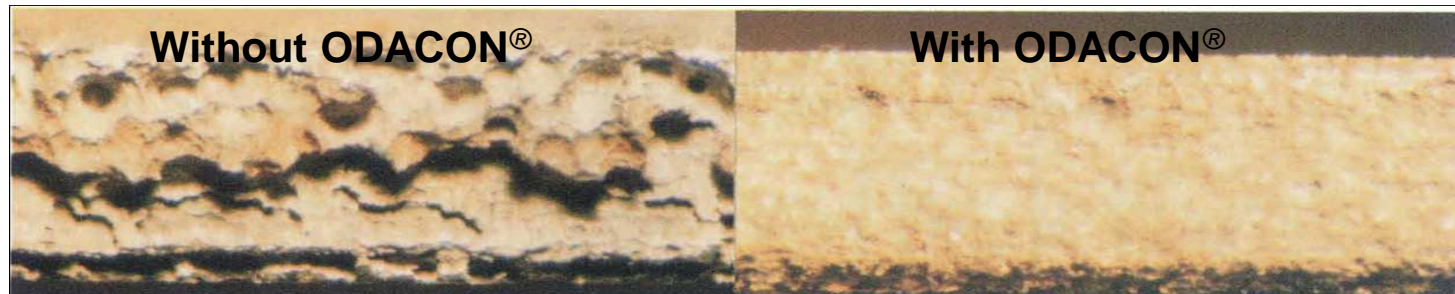


Abrasion through erosion in wet steam as a function of temperature

- During condensation the droplets are diffused faster, which causes significantly weaker damages on surfaces

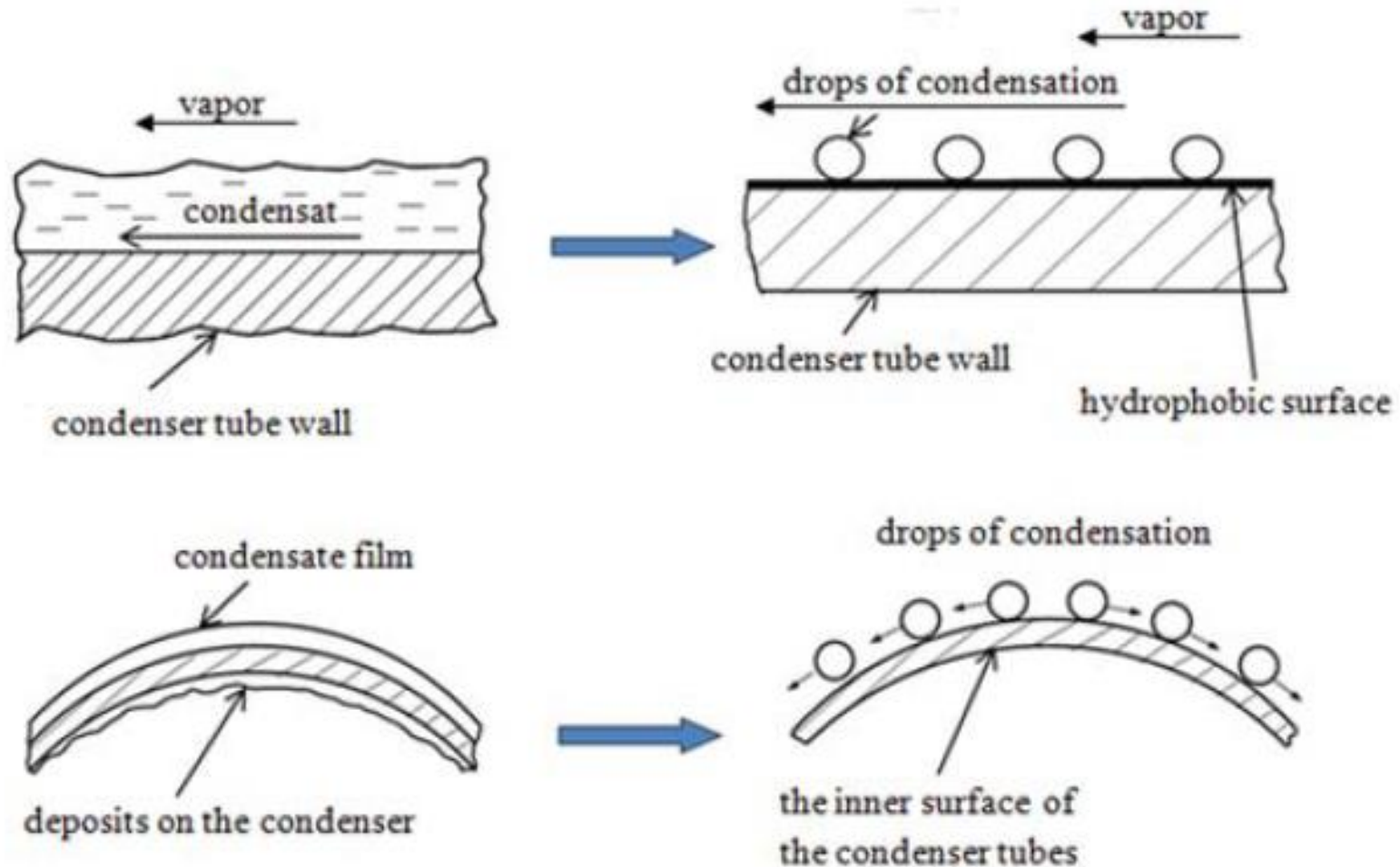


Removal rate caused by droplet impact erosion on C-steel as a function of the flow velocity



Stereo microscopic measurement (magnification 1 : 12) of material probes

Influence on condensation



Extract from WIT Transactions on Engineering Sciences,
Vol 91, 2015 "Prospects for the application of film-forming
amines in power engineering"

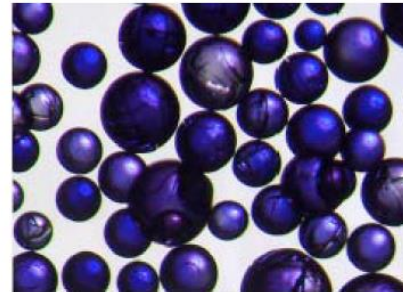
- Change from film condensation to dropwise condensation leads to an increase of the heat transfer

Effect to condensate polishing resins

- The capacities reached by the SAC of the FFA-test do not differ significantly from the blind test's results.
- The resin from FFA-test shows fouling symptoms which decrease after regeneration to a level comparable to the blind test resin.



ODACON treated SAC after
regeneration



Blind test SAC after
regeneration

- ODACON is removed down to a presumably tolerable residual level during usual technical regeneration.
- after seven cycles of loading with ODACON containing feedwater, there are no vital negative effects on the model plant detectable
- During 4 years of operation at NPP Greifswald no negative effect to the resins because of ODA treatment were detectable

Extract of a study from MIONTEC GmbH Leverkusen, 2010

Effect on online measurement system

- “... On pH, ion selective sodium measurement as well as on a Clark-type oxygen probe, no negative influence could be observed. ...”

	FFA no. 1	FFA no. 2	FFA no. 3
Coating on SC probe	No	Yes	Yes
pH drift	No	No	Yes
Retention capacity	Poor	Poor	Poor

Table 3:

Summary of results on specific conductivity, pH drift, and resin retention.

	FFA no. 1	FFA no. 2	FFA no. 3
pH stability	No influence	No influence	No influence
Sodium step response	No influence	No influence	No influence
Sodium calibration	No influence	—	—

Table 4:

Summary of results on pH stability, sodium step response, and sodium calibration.

Extract from PPChem 14(9), 2012 “Impact of Film Forming Amines on reliability of online analytical instruments”