



● POWER STATIONS

## Distillate Cooler Case Study Zaporizhzhya, Ukraine

At Zaporizhzhya Nuclear Power Plant, 2 *HydroFLOW*® Industrial test units softened heavy scale, removed biological fouling during the trial, and prevented new deposition on control beacons.

**3.65x**

Carbonate Reduction



No biofouling detected

**+3.6**

LMTD Increase

**No**

New Deposits

### ⇒ BEFORE & AFTER

#### ● BEFORE

- ✗ Hard calcite deposits up to 12 mm
- ✗ Sludge, biofilm and putrefactive odour
- ✗ Snails found inside heat exchange tubes

#### ● AFTER

- ✓ Deposits softened, cracked and reduced
- ✓ Biological fouling removed during trial
- ✓ No new scale observed on control beacons

**BEFORE***Heavy carbonate scale inside pipe***AFTER***Softened and reduced deposits*

## OVERVIEW

Zaporizhzhya Nuclear Power Plant is Europe's largest nuclear station, with six 1000 MW units. This trial focused on two distillate cooling heat exchangers that had developed hard carbonate scale, sludge, biofilm and snail fouling on water supply pipes, covers, tube sheets and heat exchange tubes. Two HydroFLOW® Industrial test units were fitted to the cooling water supply lines to assess deposit control, easier cleaning and thermodynamic improvement.

## CHALLENGE

Heavy mixed deposits and biological fouling were restricting flow, reducing heat transfer and increasing maintenance.

- Very hard complex deposits up to 12 mm thick on inlet pipes and covers
- Tube sheets and tubes had slimy biological deposits with putrefactive odour
- Melanoides snails were present inside several heat exchange tubes
- Operators needed frequent cleaning and performance was deteriorating

## SOLUTION

Two HydroFLOW® Industrial test units were installed on 108 mm cooling water supply pipes upstream of the distillate coolers. Thermal sensors recorded data every two hours during the trial.

### UNIT INSTALLED

2x HydroFLOW® Industrial (test)

### PIPE SIZE

108 mm, steel ST.45.8

### INSTALLATION POINT

Cooling water supply pipes upstream of the distillate coolers

### TRIAL PERIOD

23 Dec 2019 to 27 Mar 2020



### INSTALLATION

Unit on supply pipe



### MONITORING

Signal verification



### SITE

Trial pipework

## RESULTS

### 3.65x carbonate reduction

Lab analysis showed carbonates in hard pipe deposits fell from 63.93% to 17.5%.

### Biological fouling removed

Biological fouling was removed during the trial, along with slime and putrefactive odour.

### No new scale observed

Control beacons on pipes and tube sheets showed no new hard deposit formation during trial

### Deposits became removable

Previously hard calcite layers became brittle and could be removed with simple tools.

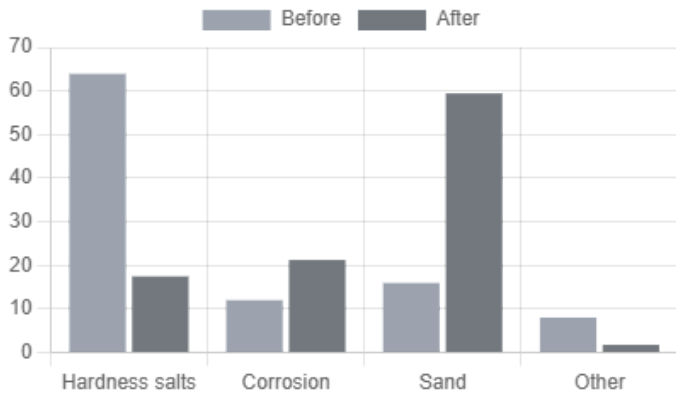
### Steady LMTD increase recorded

A steady increase in LMTD was recorded from 47.46 to 51.08 during the trial.

### Snails no longer detected

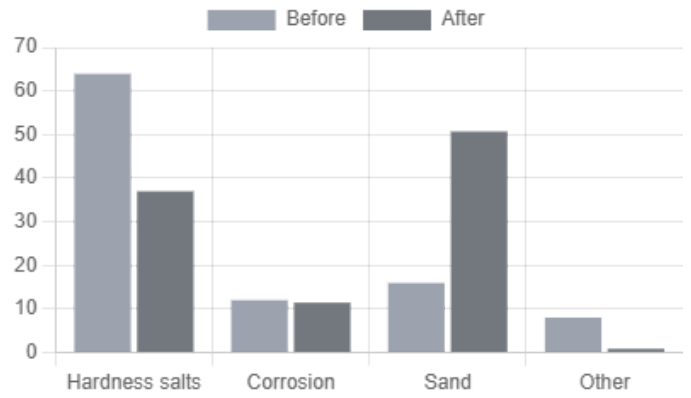
Endoscope checks found no previously recorded Melanoides snails in the heat exchange tubes

### Reduction in hard scale (Object 0)



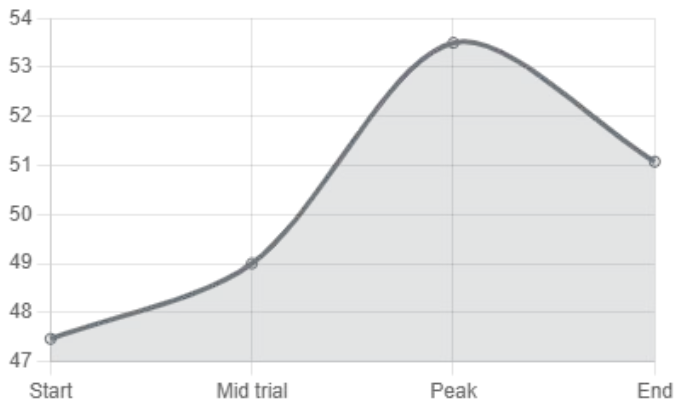
Deposit samples showed reduced bound scale and loose material after treatment.

### Deposits became looser (secondary sample)



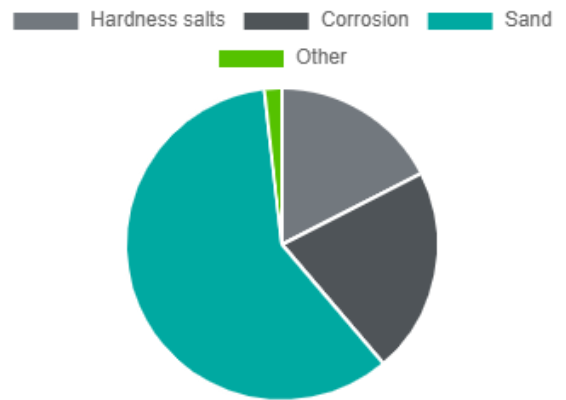
Final samples showed a shift away from hard bound scale towards looser material.

### LMTD trend during the trial



LMTD increased over the trial, indicating improved heat transfer performance.

### Final deposit composition (Object 0)



Final deposit sample from Object 0 showing less hard scale and loose material

**KEY TAKEAWAY** **Summary**

At Zaporizhzhya Nuclear Power Plant, Hydropath treatment with two *HydroFLOW*® Industrial test units was trialled on distillate cooler heat exchangers. The trial showed softening and restructuring of hard carbonate deposits, removal of biological slime observed during the trial, no new deposit growth observed on control beacons, and improved thermodynamic performance.

**3.65x**

CARBONATE REDUCTION

**+3.6**

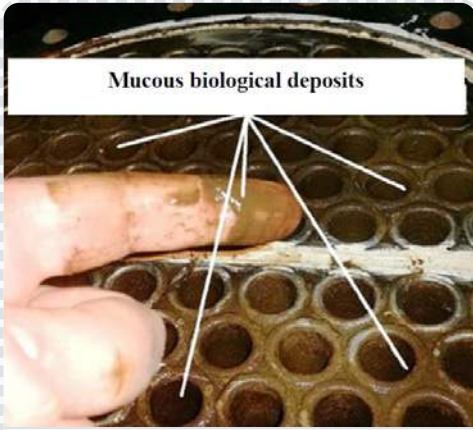
LMTD INCREASE



BIOFOULING REMOVED



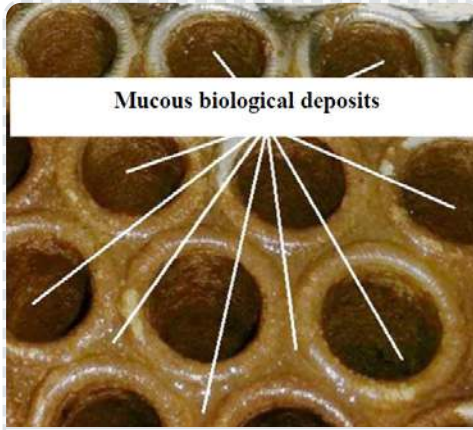
## ADDITIONAL PHOTO EVIDENCE



Mucous biological deposits

**BEFORE**

Biological deposits on the tube sheet before treatment



Mucous biological deposits

**BEFORE**

Close up of biological fouling before treatment



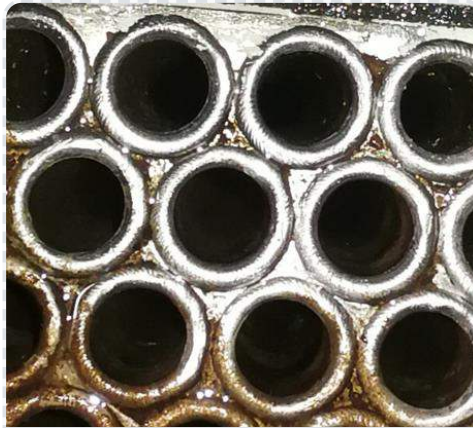
**BEFORE**

Tube sheet cleaned with a household plastic brush



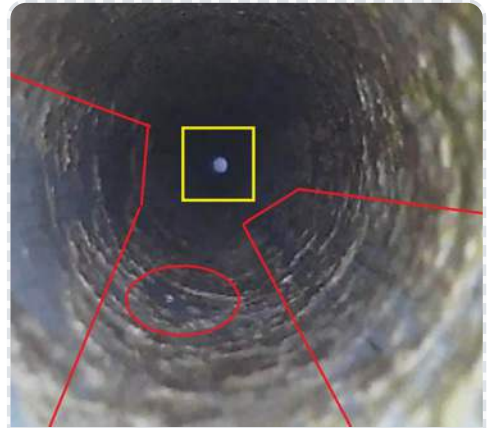
**BEFORE**

Cleaned beacons on the pipe using a household plastic brush



**AFTER**

Heat exchange tubes cleaned during final inspection



**RESULTS**

Carbonate layer loosened inside the tube wall



**RESULTS**

Sampling deposits from the inner surface of the heat transfer tube



**BEFORE**

Pipe surface before treatment, close up view



**AFTER**

Pipe surface after treatment, close up view

**HYDROPATH**

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