Low Temperature Corrosion in a Waste Fired Boiler

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Introduction

Åmotfors Energi AB
Varmland
Sweden

27,4 MWth
10 t/h waste throughput

First fire 12/02/2010

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Introduction

Solid Waste

Waste pre-treatment

DANO® drum

Waste-to-Energy Air Pollution Control

Waste-to-energy plant

Water treatment

Wastewater treatment

CAS, UNITANK ® & UNIBRANE ®

• Process- & Drinking water treatment
• Desalination

NEWATER / MEMSTILL®

Sludge treatment

Sludge drying/pelletising/ incineration

HARDPELLETISER
ZEROFUEL™

Sludge digestion

For energy recuperation

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NextGenBioWaste-project

SP 2 - Boiler Optimisation

WP 2.6 : Ecoprobe

Life test of Acid Dewpoint in a WtE plant

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Basics: Acid Dewpoint

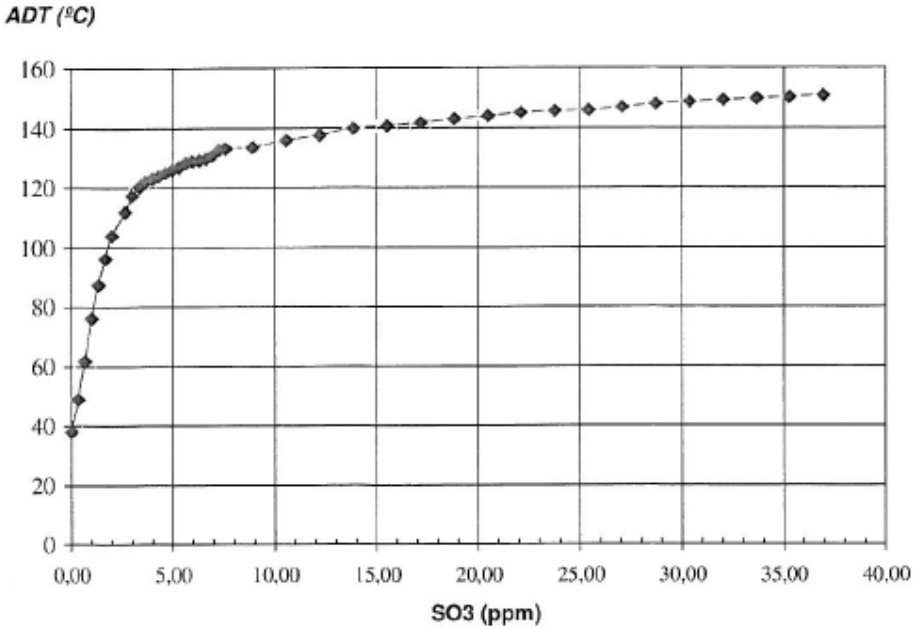
ADT = Acid Dewpoint Temperature

$SO_2\,(g) + ½\,O_2\,(g) \rightarrow SO_3\,(g)$

$SO_3\,(g) + H_2O\,(g) \rightarrow H_2SO_4\,(g)$

$H_2SO_4\,(g) \overset{T < ADT}{\rightarrow} H_2SO_4\,(l)$

- Presence of catalyst
- Fly ash as absorber
- Soot as condensation site
- Excess air conditions
- Water content
- Temperature



[Blanco J.M. and Pena F., Appl. Ther. Eng (2007)

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Objectives

Goals

- Collection of plant-scale data on acid dewpoint corrosion at the exit of a WtE-boiler
- Experimental assessment of risk on acid dewpoint corrosion

➡ **Ultimate aim**

Optimisation of WtE-boiler design by reducing excessive safety margins on :

- BFW-temperature
- Flue Gas temperature

➡ **Increase efficiency - increase operational revenue**

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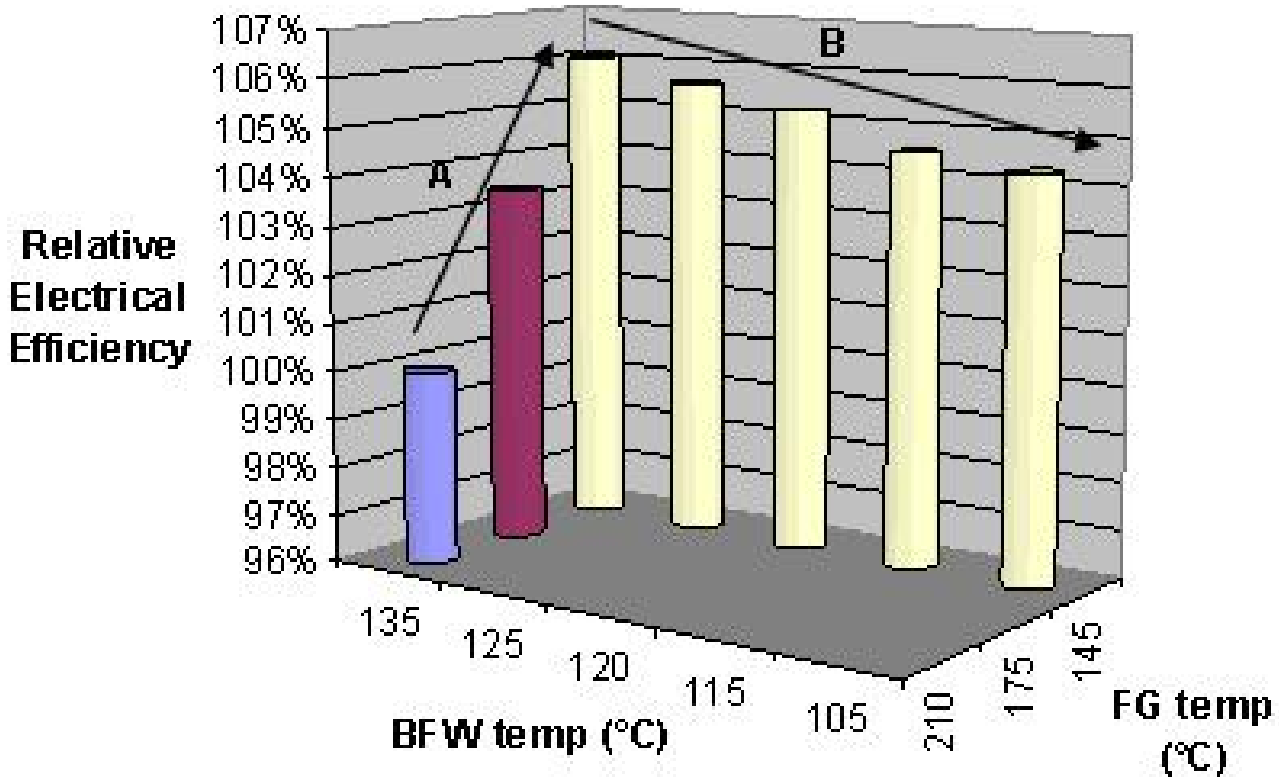
Objectives

Simulation - potential electrical efficiency gain



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Approach

How ?

- Insert water-cooled probe of economiser material (ST45.8) in end boiler near economizer section

- Observe corrosion phenomena (s.a. type, depth, intensity, ...) at various temperatures for 60 days

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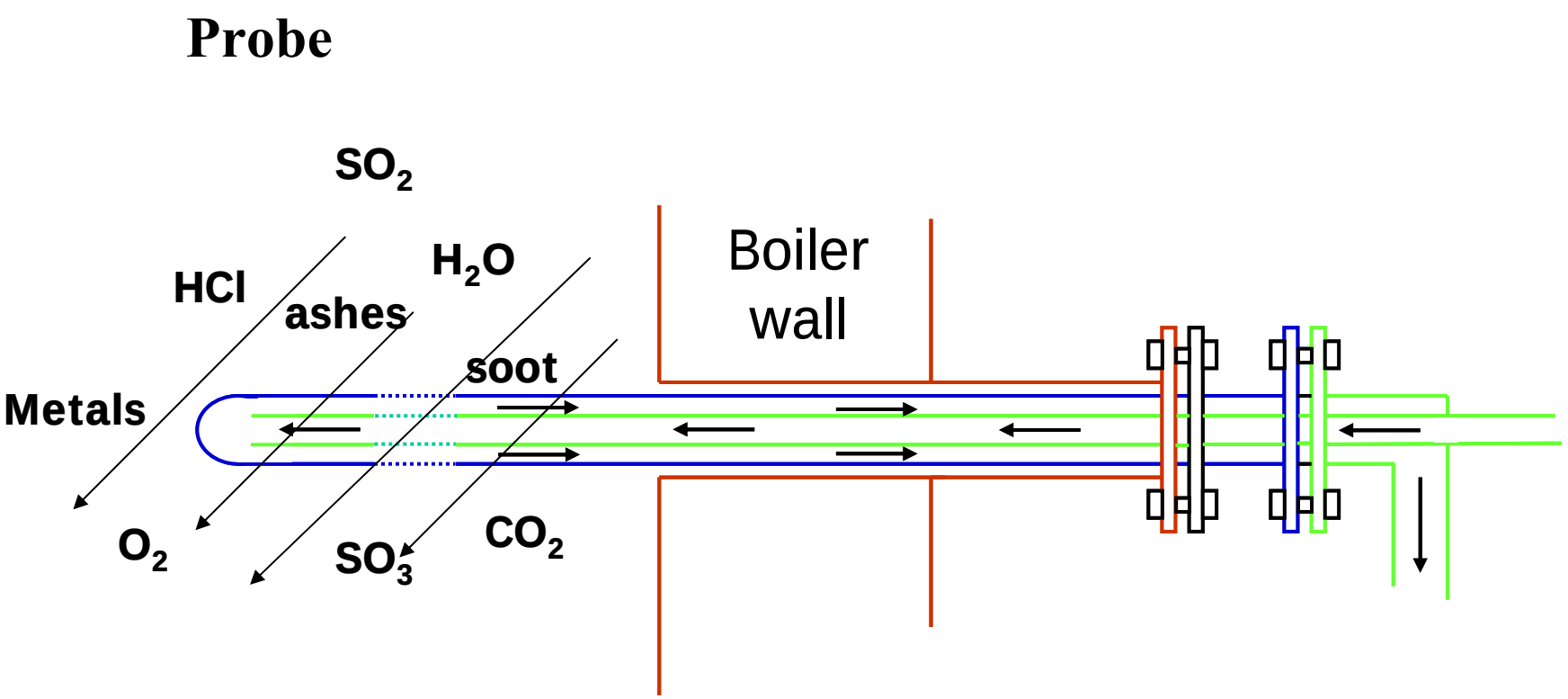
Ecoprobe



and many other …

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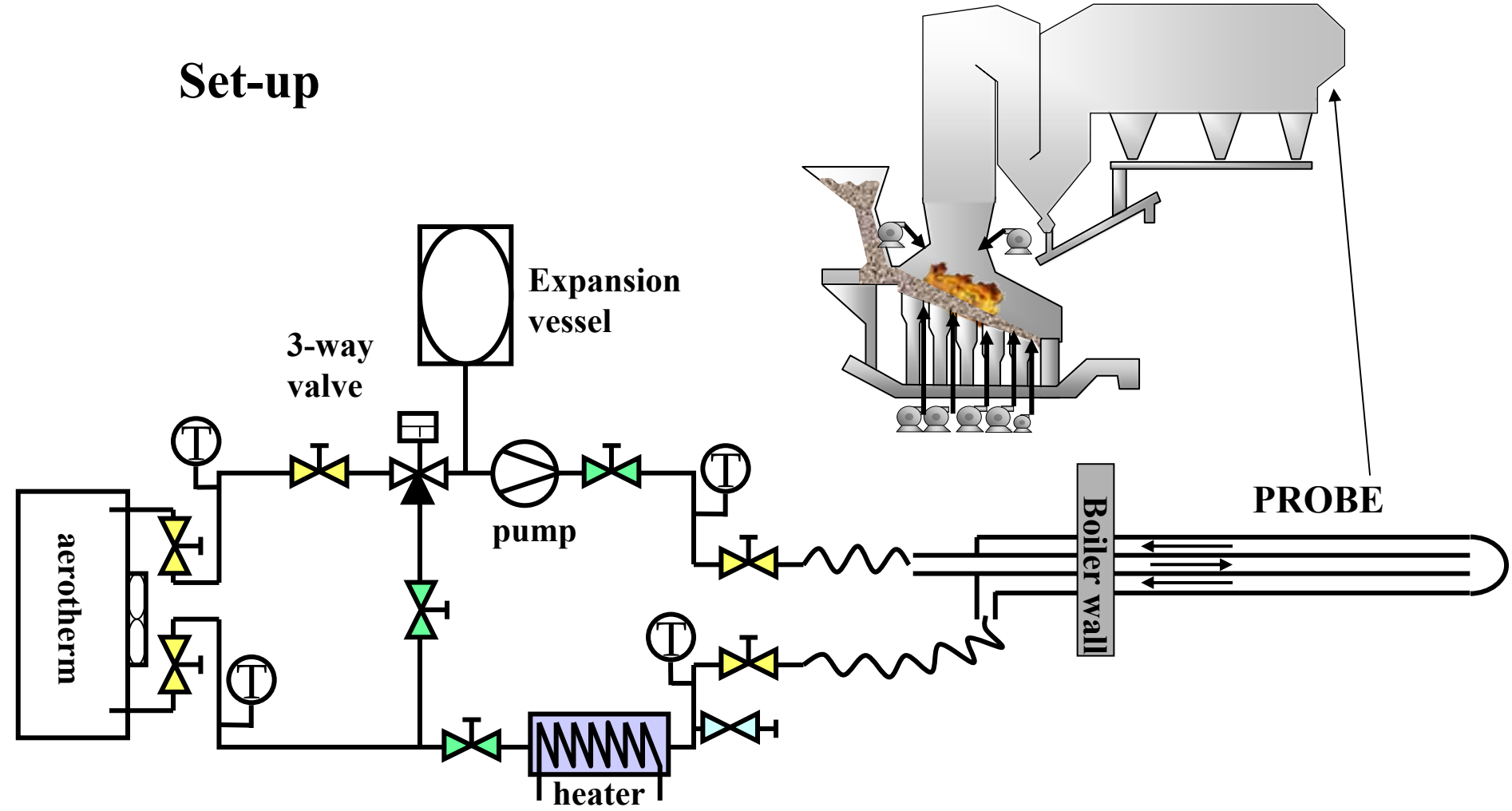
Experimental set-up



Experiment Location

Antwerpen-Wilrijk (Flanders)

Client: ISVAG

Capacity: 2 x 288 tonnes/day

Calorific value: 8 MJ/kg

Thermal power: 2 x 28 MW_{th}

Electrical power: 12 MW_e

Flue gas treatment: SNCR + ESP + semi dry + AC injection + fabric filter + wet

Capacity: 2 x 65,000 Nm^3/h

Start-up: 1999

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Range of Measurement

Estimation of expected ADT

Plant data ISVAG:

Flue gas flow	**56 000**	**Nm^3/h**
O_2	**6 - 8**	**Vol. %**
H_2O	**12 - 15**	**Vol. %**
HCl	**600 – 1500**	**mg/Nm^3 11%O_2 dry**
SO_x	**50 - 350**	**mg/Nm^3 11%O_2 dry**
T	**250**	**°C**

⇨ Dewpoint expected between 105 and 120 °C

[Predicting Dew Points of Flue Gases, Verhoff & Banchero, Chem. Eng. Prog. 70, 8, 71-72 (1974)]

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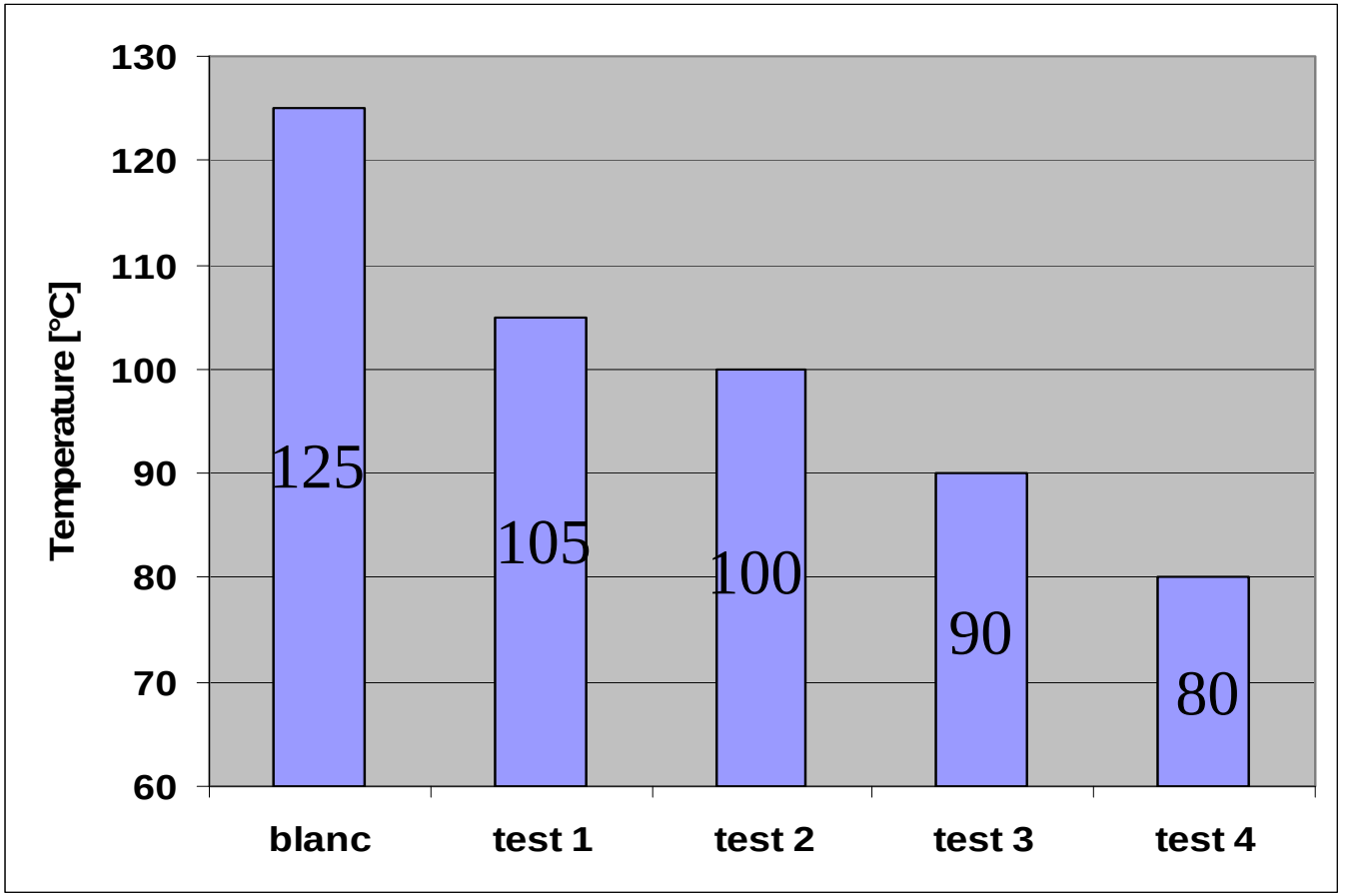
Experiments

T = 60 days



Results

T = 0 days

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Results

T = 30 days

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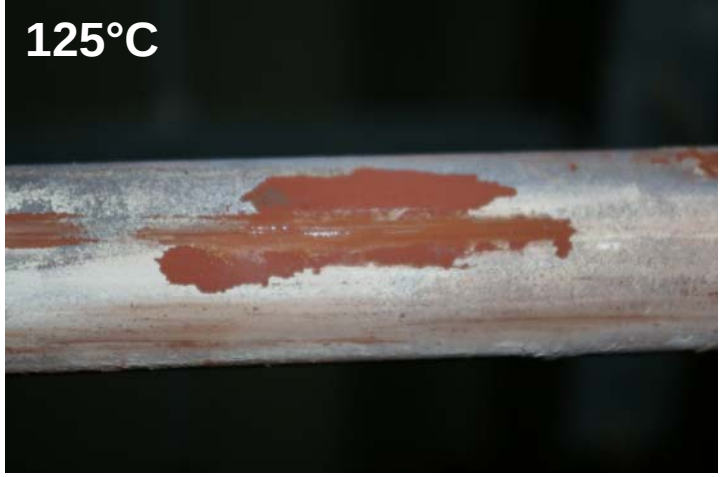
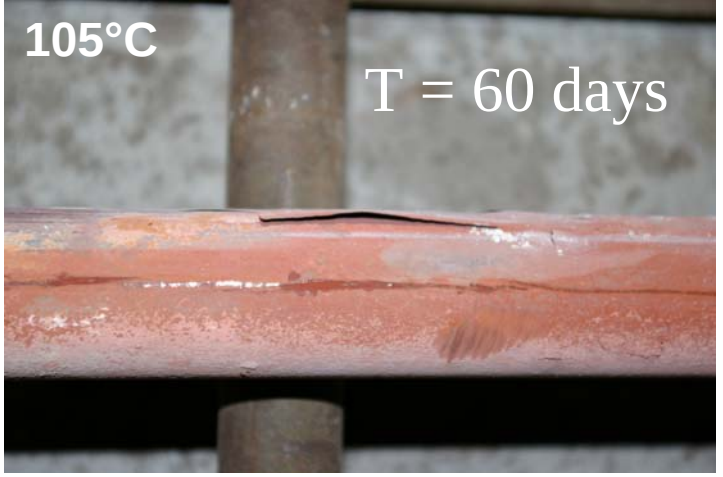
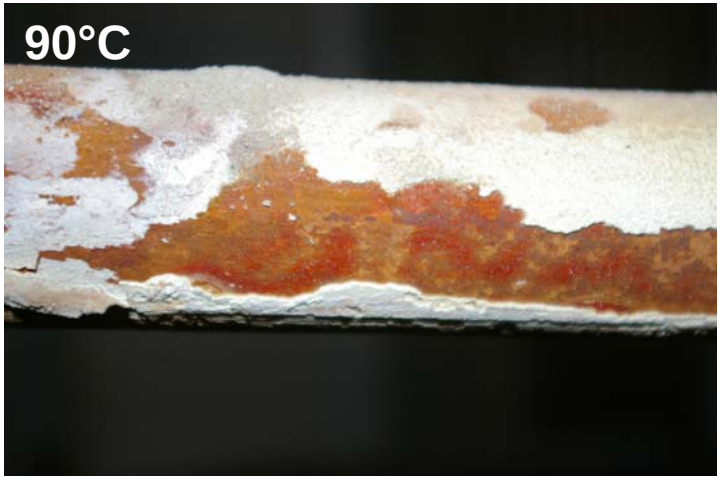

125°C


105°C
T = 60 days


100°C


90°C


80°C


new

Results

SEM-pictures

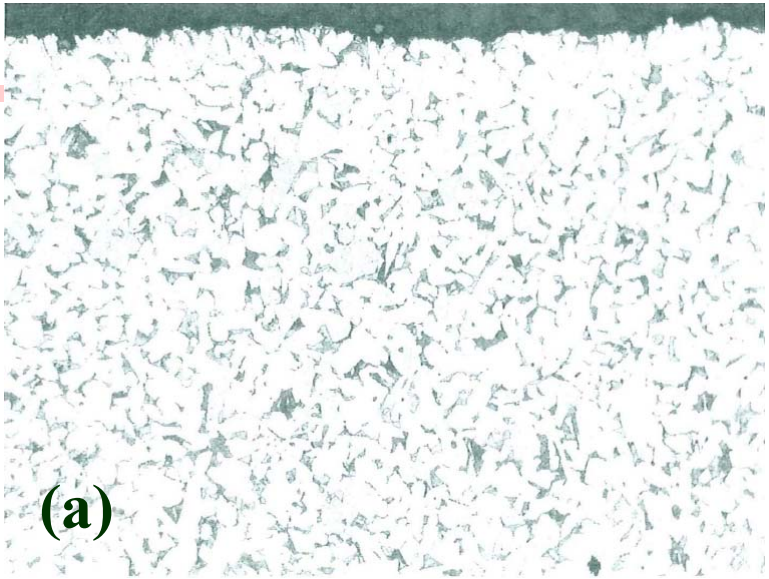
Magnitude 200 x

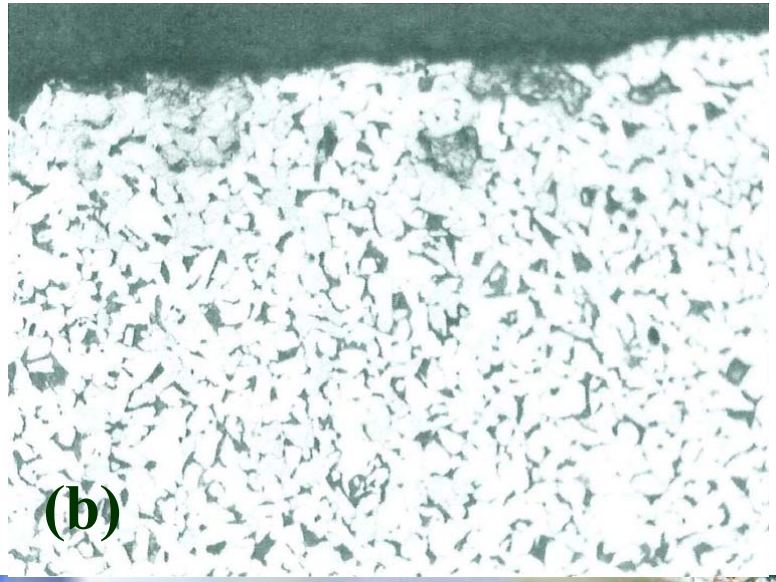
Nital surface treatment

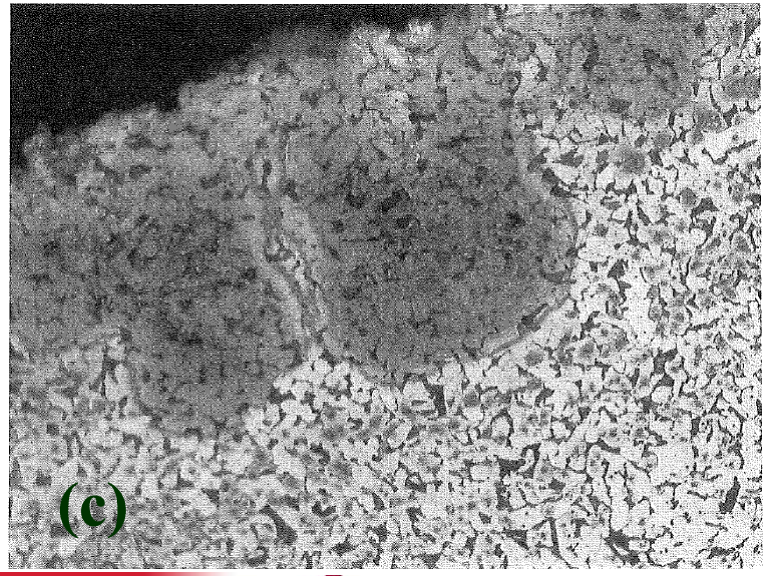
(a) Blanc

(b) 90°C

(c) 80°C







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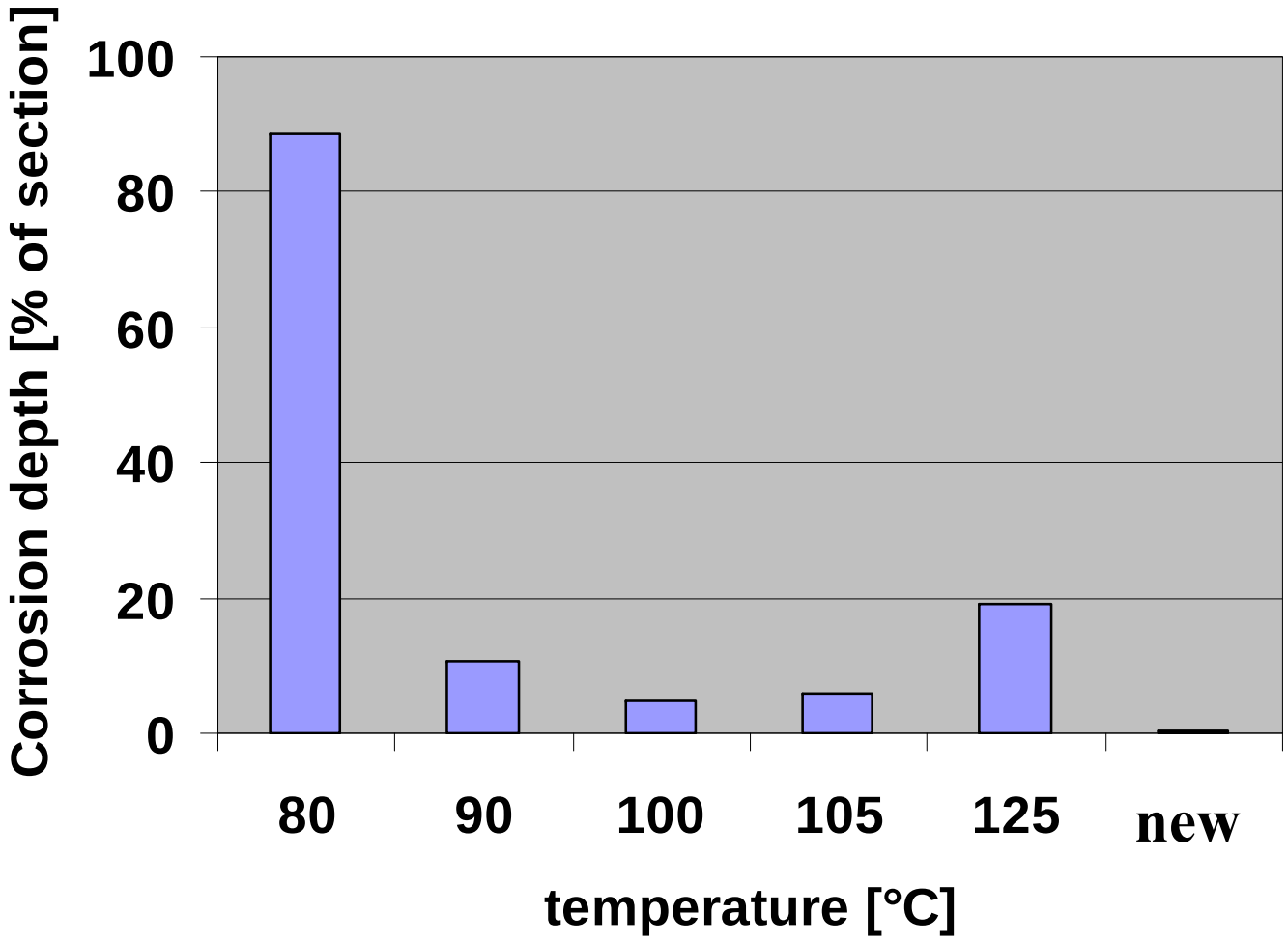
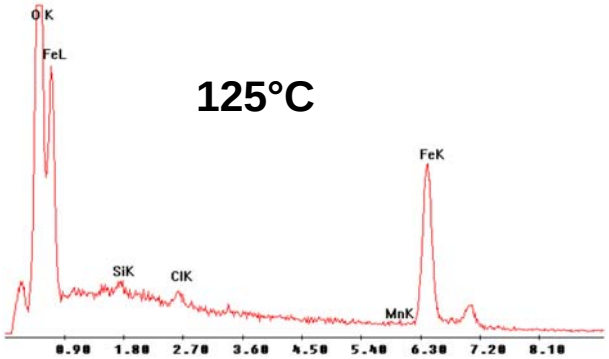
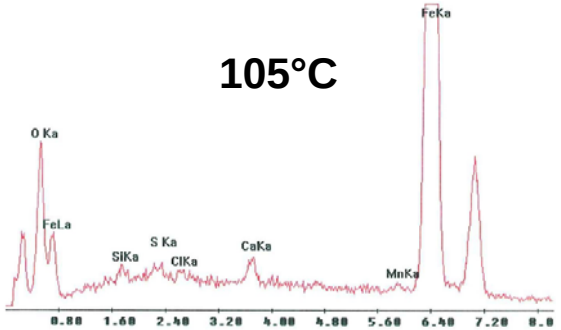
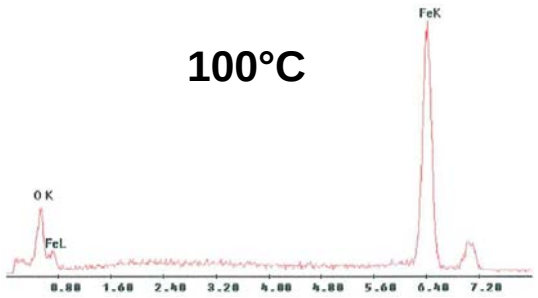
Results

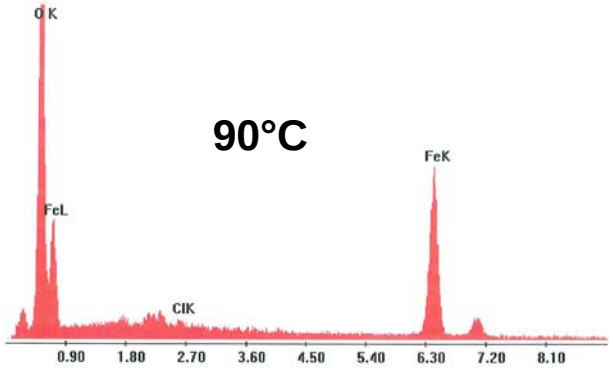

Corrosion depth [% of section]
100
80
60
40
20
0
80
90
100
105
125
new
temperature [°C]

SEM/EDAX

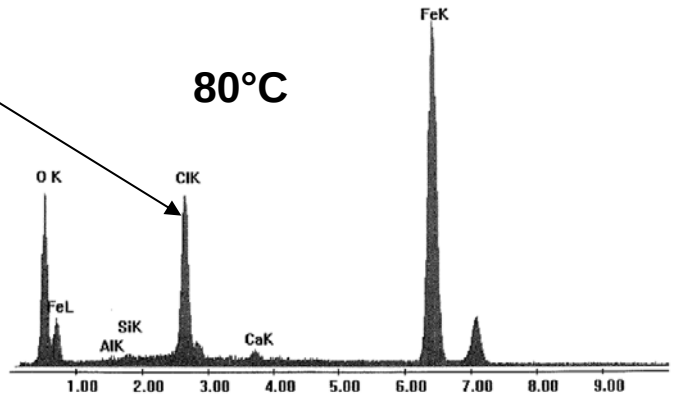








Cl



Analyse	
%O	30,35
%Al	0,2
%Si	0,27
%Cl	11,37
%Ca	0,63
%Fe	57,18

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Results overview

	125 °C 1440h	105 °C 1440h	100 °C 1440h	90 °C 1440h	80°C 1440h
type	Fe_2O_3	Fe_2O_3	Fe_2O_3	Fe_2O_3	Fe_2O_3
intensity	superficial	superficial	superficial	superficial	deep – entire section
Depth (mm)	0.4 to 0.6	0.15	0.1 to 0.15	0.2 to 0.35	2.0 to 2.6
decrease thickness tube wall	no	no	no	no	no
Cl	+	+	-	+	+++
S	-	+	-	-	-

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Summary

- Superficial corrosion at 125, 105, 100 and 90 °C
- No significant difference between 125, 105, 100 and 90°C
- Very intense corrosion at 80°C
- Cl appears to contribute (HCl ?)

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Conclusions

- The onset of low temperature corrosion in a waste fired boiler is situated between 80 and 90°C (FGT 240°C)
- BFW at 105°C represents no corrosion risk
- Room for Energetic/Revenue optimisation

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Thank you for your attention

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