

**Surface treatment of Magnesium**

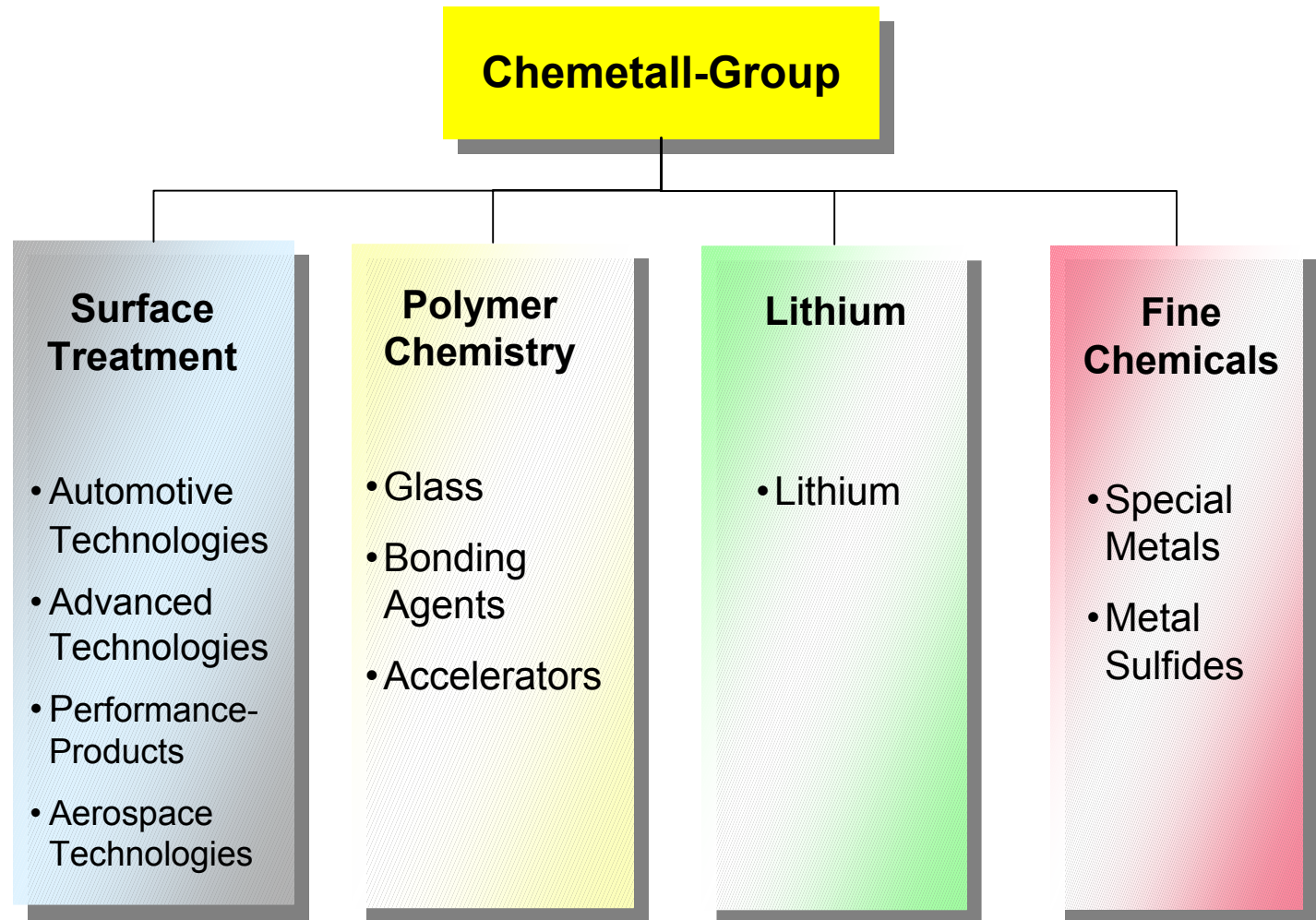
- Introduction
- Description of cleaner products
- Description of pickling products
- Conversion coating
- Paint
- Corrosion tests
- Results
- Analytical results
- Plant engineering
- Summary

# Surface Treatment

Effect of cleaning and pickling on the quality of chrome free conversion treatments

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# Description of cleaner products

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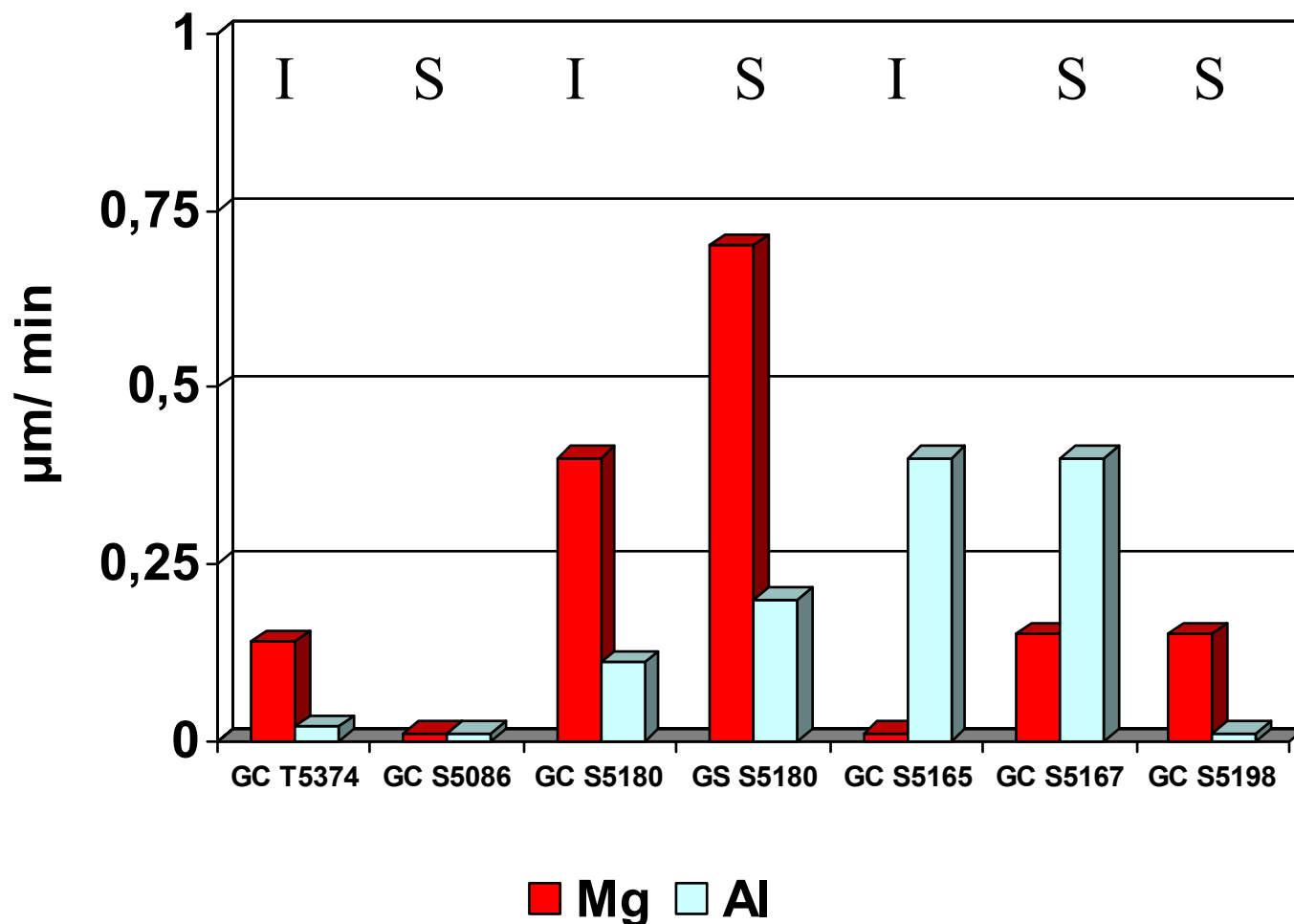
Product	Application	pH – value	Temperature
GC T 5374	Immersion	9,5 ... 10,0	60 ... 70°C 140 ... 158 F
GC S 5086	Spray	9,5 ... 10,0	55 ... 65°C 131 ... 149 F
GC S 5180	Spray / Immersion	10,5 ... 11,0	55 ... 65°C 60 ... 70°C
GC S 5165	Immersion	11,5 ... 12,0	60 ... 70°C 140 ... 158 F
GC S 5167	Spray	11,5 ... 12,0	55 ... 65°C 131 ... 149 F
GC S 5198 Silicate based	Spray	11,0 ... 11,5	55 ... 65°C 131 ... 149 F

# Description of cleaner products

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## Pickling attack



# Description of pickling agents

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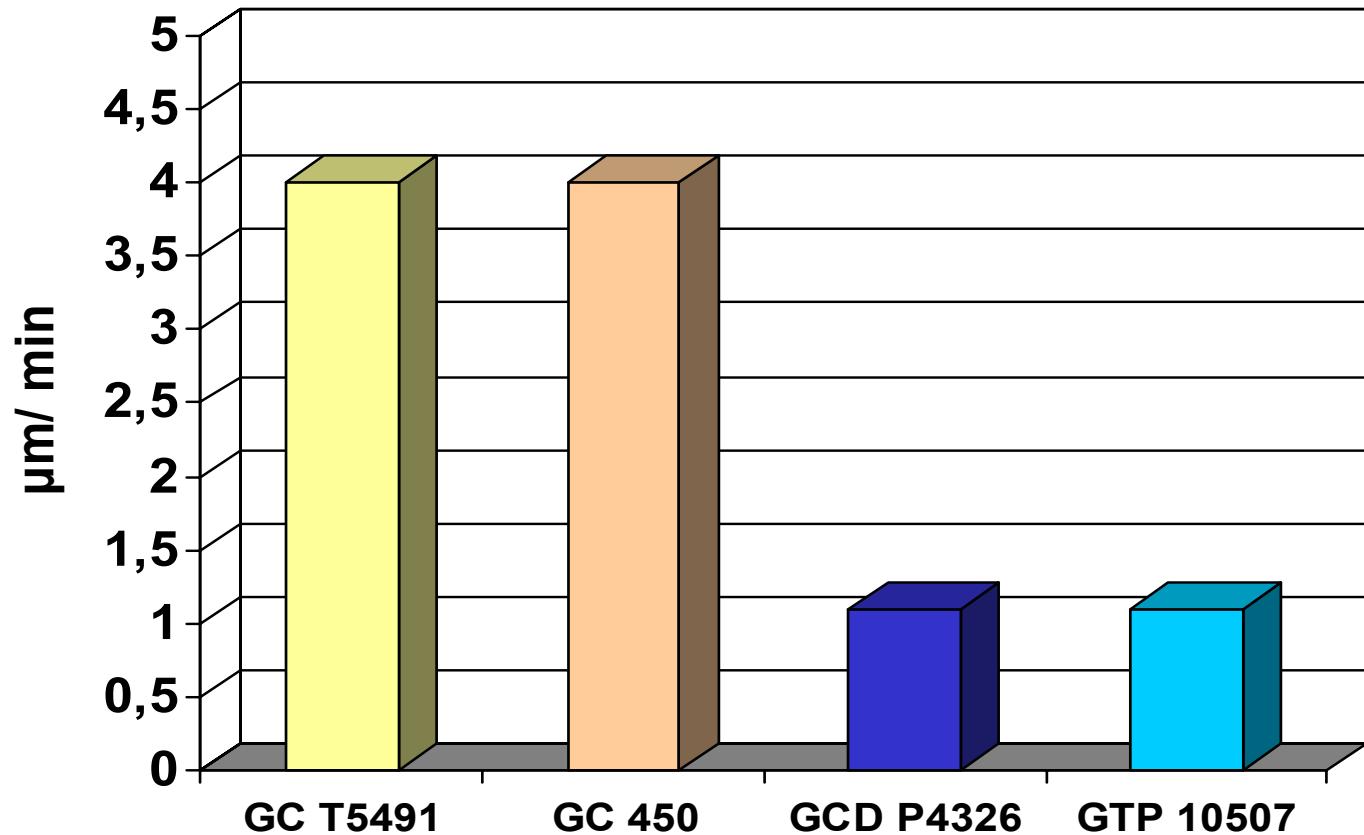
Product	Application	pH – value	Basis
GC T 5491	Immersion	< 1,5	Sulphuric acid
GC 450	Spray	< 1,5	Sulphuric acid
GC P4326 (Framalite FMM3)	Immersion	<1,5	Nitric acid
GTP 10507	Immersion	2,0 ... 2,5	Organic acid

# Description of pickling agents

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## Pickling attack



# Conversion treatment

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## Gardobond X4707

### Chrome-free Treatment for Mg and Al

Basis : Titan- und Zirconfluoride

Application: spray or immersion

temperature	: 20°C – 30°C
	68 F – 86 F
time	: 1-2 min
pH	: 2,0 – 3,0

Comparison: Yellow Chromatation  
Gardobond C722

# Paint

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## Powder Paint

### Interpon 700 (Akzo Nobel Powder Coatings)

Basis : Epoxy Polyester  
Coating thickness : 60 µm

## E-Coat

### Cathoguard 400 (BASF)

Lead free E-Coat  
Coating thickness : 20 µm



# Corrosion tests

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## Salt Spray Test to DIN 50 021

The salt spray test to DIN 50021 is performed as an accelerated test. The NaCl solution (5%) is sprayed at 35°C continuously during the entire test period.

## Salt Spray / Humidity Cycle Test (VDA) 621-415

A test cycle lasts 7 days and consists of

1 day = 24 h      salt spray test SS DIN 50021  
4 days = 4 x 24 h   humidity cycle test KFW DIN 50017  
2 days = 48 h      room temperature + room humidity

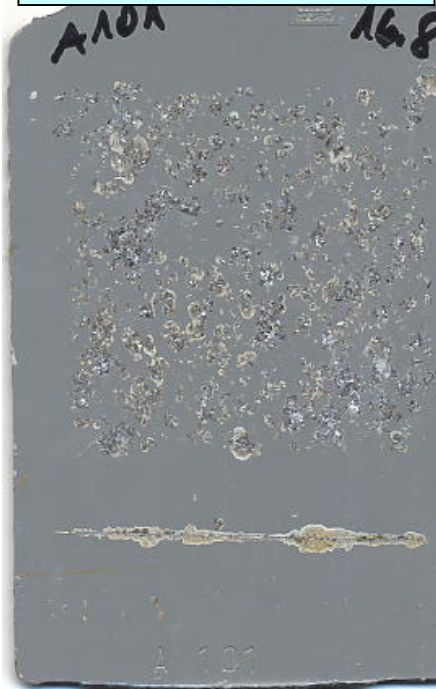
## Stone Chipping Test, Multi-impact 621- 427

500g chilled cast shot is projected onto the test surface

# Cleaner + Gardobond X4707 + E-Coat

## VDA – Cycle test, 3 cycles

**GC T5374**



**pH: 9,5 – 10,0**

**Pickling attack:  
0,3 µm**

**GC S5165**



**pH: 11,5 – 12,0**

**Pickling attack:  
< 0,01 µm**

**GC S5198**



**pH: 11,0 – 11,5 +Si**

**Pickling attack:  
0,4 µm**

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**AM 50**

# Results Gardobond C 722, E-Coat

## VDA – Cycle test, 3 cycles

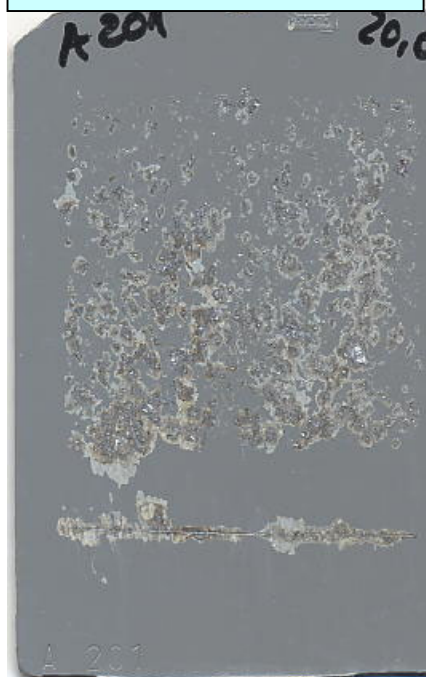
**GC T5374**



**pH: 9,5 – 10,0**

**Pickling attack:  
0,3 µm**

**GC S5165**



**pH: 11,5 – 12,0**

**Pickling attack:  
< 0,01 µm**

**GC S5198**



**pH: 11,0 – 11,5 +Si**

**Pickling attack:  
0,4 µm**

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# Cleaner + Pickling + Gardobond X4707 + E-Coat

## VDA – Cycle test, 3 cycles

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**Without  
pickling**



**GC T5491**

**Identical with  
GCD P4326**



**GTP 10507**

**GC T5374**

**AM 50**



# Cleaner + Gardobond X4707 + E-Coat

## Salt spray test 1008h

**GC T5374**



**pH: 9,5 – 10,0**

**Pickling attack:  
0,3 µm**

**GC S5165**



**pH: 11,5 – 12,0**

**Pickling attack:  
< 0,01 µm**

**GC S5198**



**pH: 11,0 – 11,5 +Si**

**Pickling attack:  
0,4 µm**

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# Cleaner + Pickling + Gardobond X4707 + E-Coat

## Salt spray test 1008h

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**Without  
pickling**



**GC T5491**

**Identical with  
GCD P4326**



**GTP 10507**

**GC T5374**

**AM 50**

# Cleaner + Pickling + Gardobond X4707 + E-Coat

## VDA – Cycle test, 5 cycles

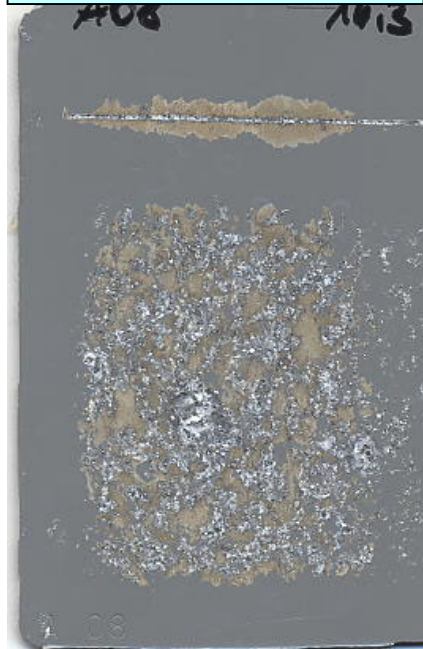
**GC T5374**



**pH: 9,5 – 10,0**

**GC T5491**

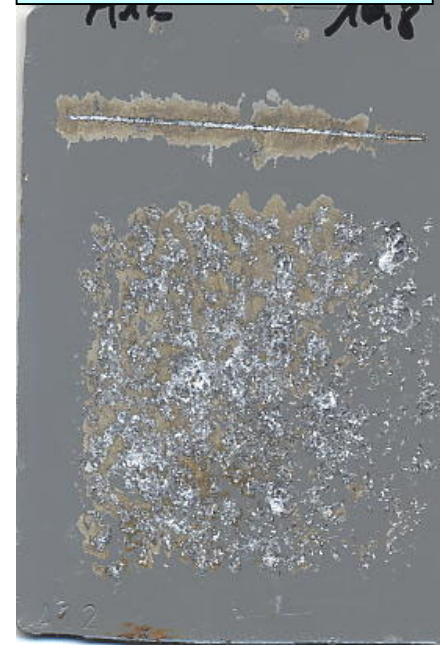
**GC S5165**



**pH: 11,5 – 12,0 T**

**GC T5491**

**GC S5167**



**pH: 11,0 – 11,5 S**

**GC T5491**

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# Cleaner + Pickling + Gardobond X4707 + Powder

## Salt spray test 1008h

**GC T5374**



**pH: 9,5 – 10,0**

**GC T5491**

**GC S5165**



**pH: 11,5 – 12,0 T**

**GC T5491**

**GC S5167**



**pH: 11,0 – 11,5 S**

**GC T5491**

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**AM 50**



# Best combination Cleaner + pickling + GB X4707

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AZ 50

## Salzsprühtest 1008h



**immersion**

**GC T5374**

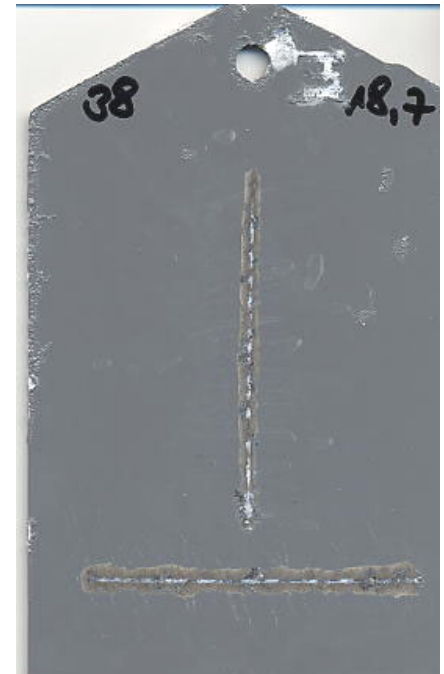
**GC T5491 or  
GCD P4326**



**Spray**

**GC S5086**

**GC 450 or  
GCD P4326**



**Spray**

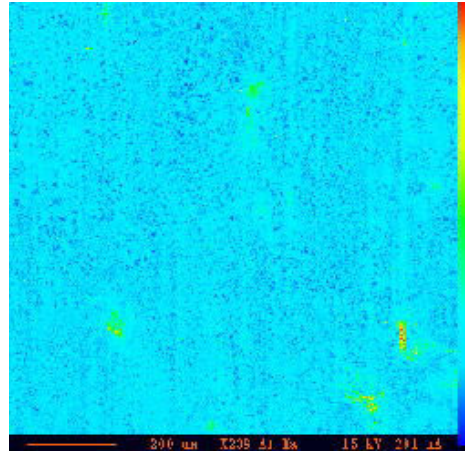
**GC S5180**

**GC 450 or  
GCD P4326**

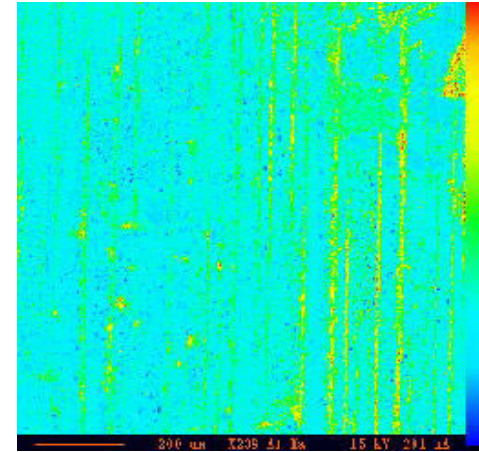
# Electron Microprobe Analysis, element distribution

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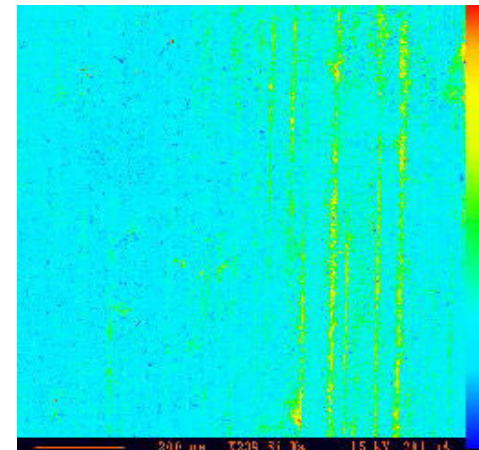
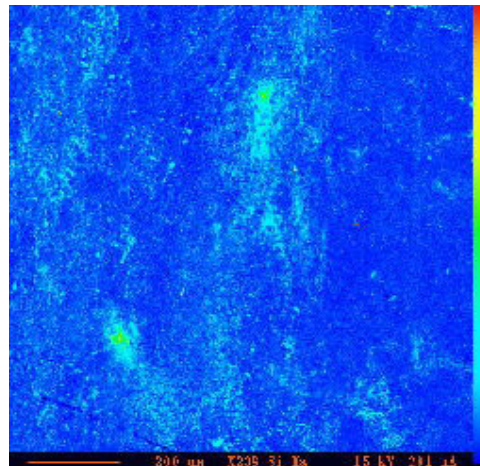


min. Intensity



max. Intensity

Al Kα



Si Kα

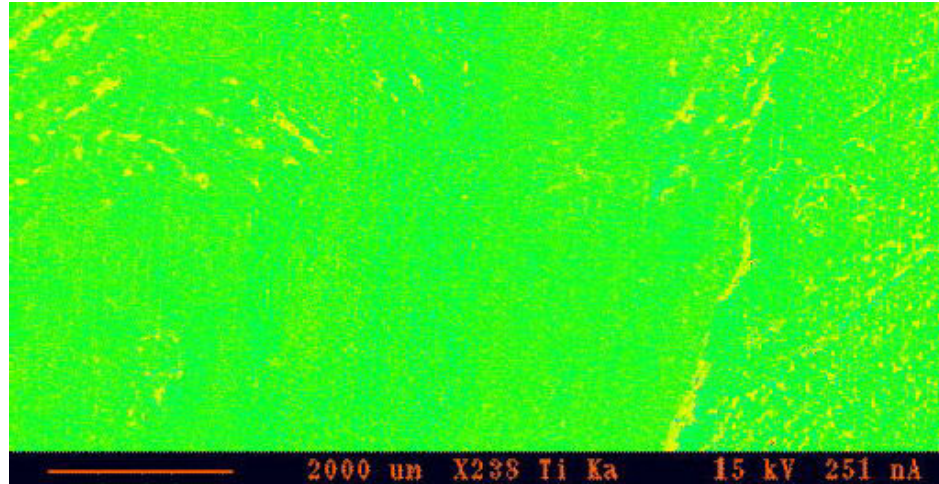
GC T5374

GC S5198

# Electron Microprobe Analysis, element distribution

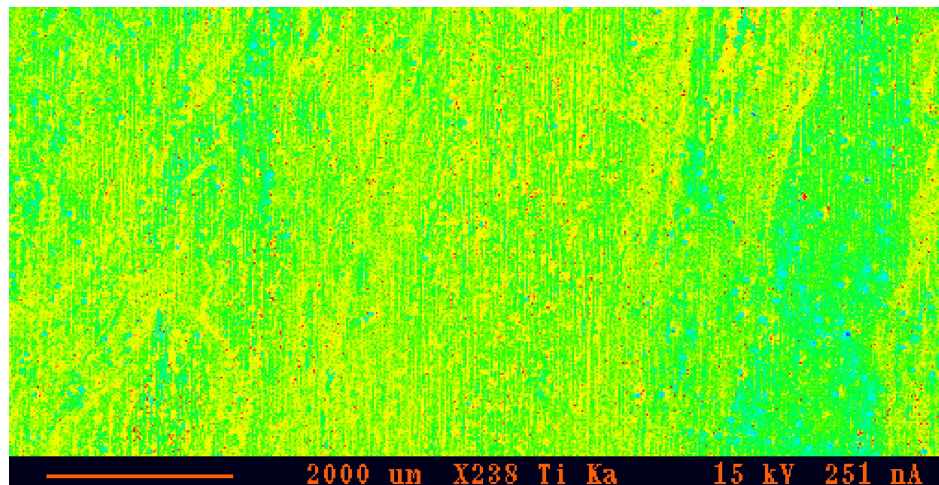
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**Ti K $\alpha$**

**GC T5374/  
GC 450 /  
GB X4707**



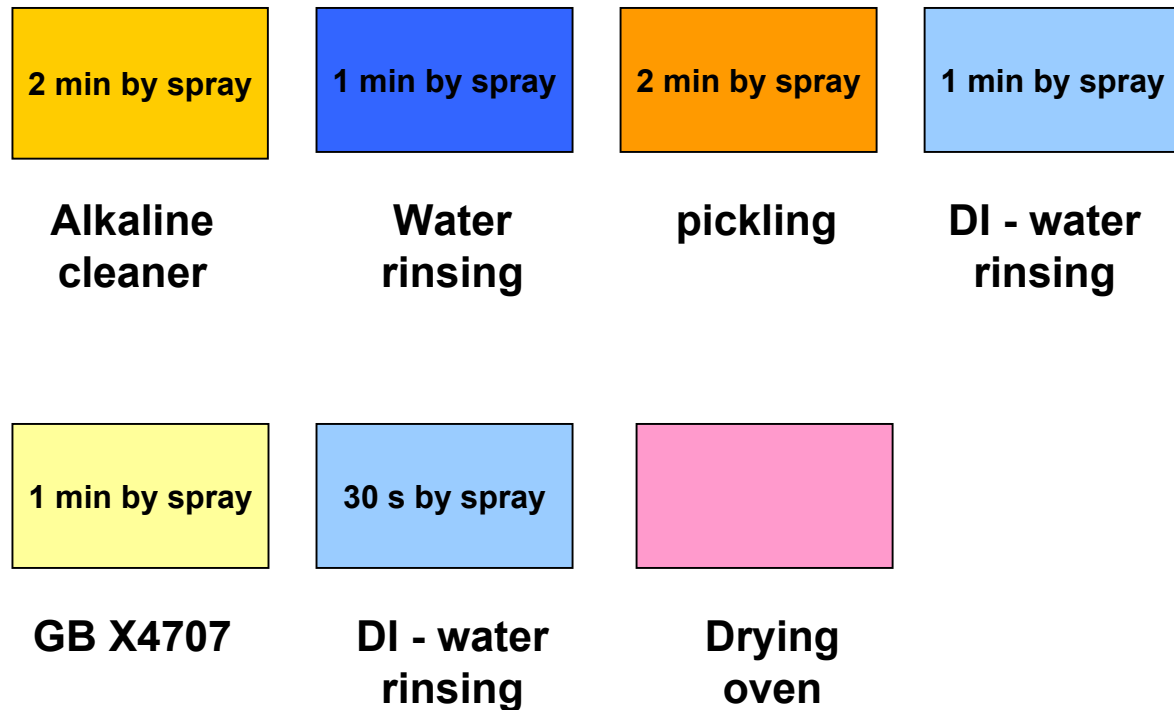
**GC S5198 /  
GC 450 /  
GB X4707**



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## Recommended process



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## Summary

- ✓ **Strong alkaline and silicate-based Cleaner worsen the results**
- ✓ **A pickling step is necessary for good adhesion and corrosion resistance**
- ✓ **When proper cleaning/pickling is done, chrome-free alternatives based on Ti and Zr show similar quality as chromate**