Refractory Anchors for Monolithic Applications

ANCHORS, YOUR REFRACTORY ANCHORS PARTNER

Introduction

New challenge for refractory anchor solutions:

- Evolution of refractory castable; LC, LCC, new binder technology…
- Developement of new applications as municipal waste incinerators, biomass boilers
- Use of low quality fuels and alternatve fuels

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What is a refractory anchor (its function)?

An anchor is a system used to stabilize, hold a volume of refractory materials on a steel casing by developing a holding capacity in several directions

There is no good refractory solution without a good anchor system

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How to design a refractory anchor

1. Determine the correct alloy
2. Determine the anchor shape
3. Determine the anchor dimensions

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Determine the alloy

- The process temperature,
- The type of atmosphere (oxyding or reducing)
- The chemical composition of the atmosphere in order to determine if you could have problems with chemical attacks, alkalies …
- The process type (continuous / cyclic / temperature evolution),
- The mechanical stress linked to the process and to the refractory lining (weight and expansion),
- The fuels,
- The nature of the processed product.

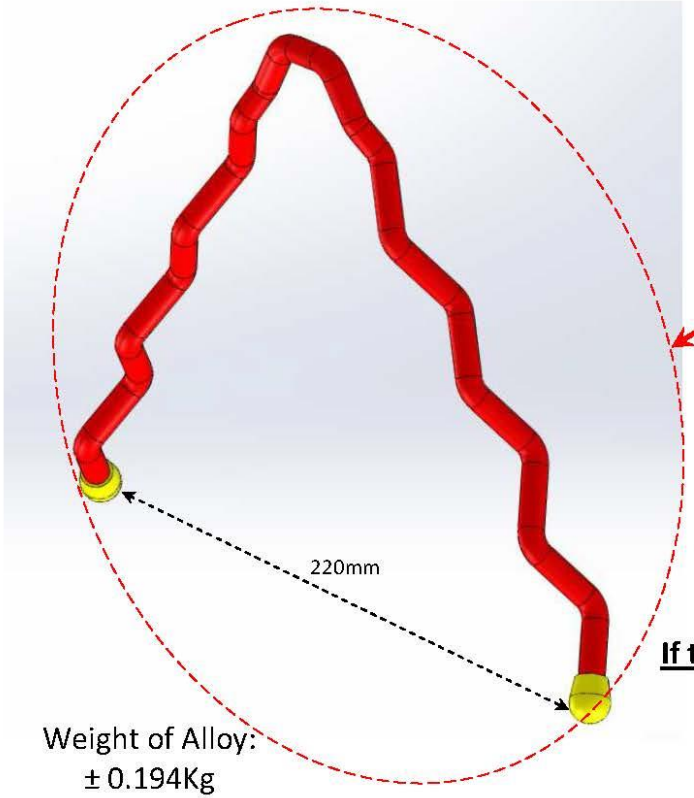
Determine the shape

- The lining thickness,
- The number of layers,
- The type of insulating material (panels / bricks / Insulating castable),
- The way to install back-up insulation specially for insulating castable,
- The way to install the anchors (welding per electrodes, stud welding, bolting),
- The application.

REFRACTORY ANCHORS

ROUND OR FLAT ANCHOR

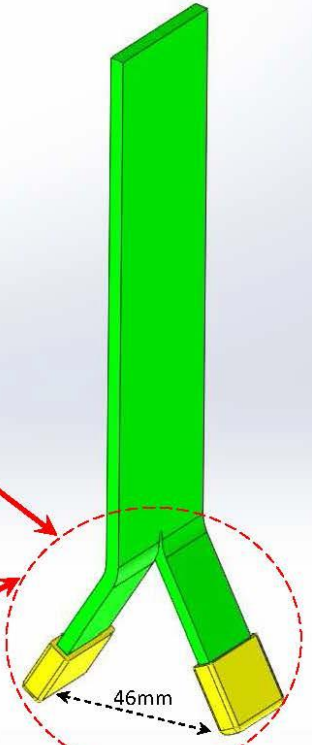
CH4.8(60) – 200 – 253MA - C



Weight of Alloy:
± 0.194Kg

EFFECTIVE ANCHORING AREA

YHA-35/4(60) – 200(150) – 253MA - C



If this part is destroyed, no anchoring anymore

Weight of Alloy:
± 0.231Kg

Determine the dimensions

The length of the anchors:

- According the thickness of the last layer (rule of 2/3)
- The distance between the top of the anchor and the lining surface according the thickness of the last layer

Determine the dimensions

The opening angle based on the thickness of the lining

- 60° as standard angle
- A reduced angle as 30°, 45° or a double angle as 15°/60° for a thick lining
- A large angle for small thickness as 80°, 90° or even until 120° for specific applications as tube walls for boiler

Determine the dimensions

The diameter:

- According the lining (thickness, weight to hold, roof section or wall)
- Eventual corrosion problem due to chemical attacks

There is no good refractory solution without a good anchor system

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How to produce refractory anchors and Quality issue due to production

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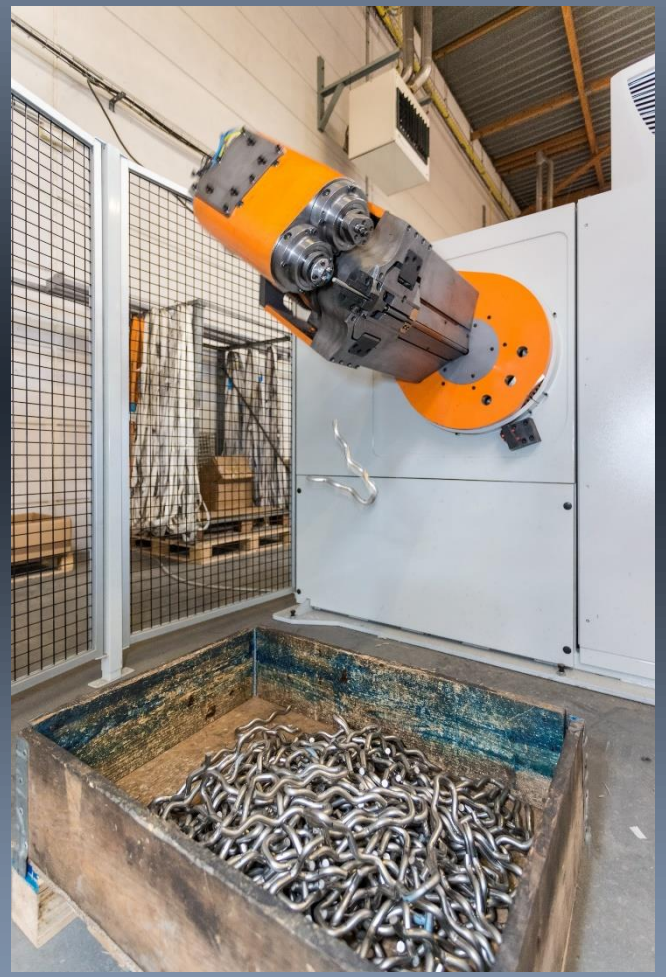
CNC ROBOT




Touch & Form
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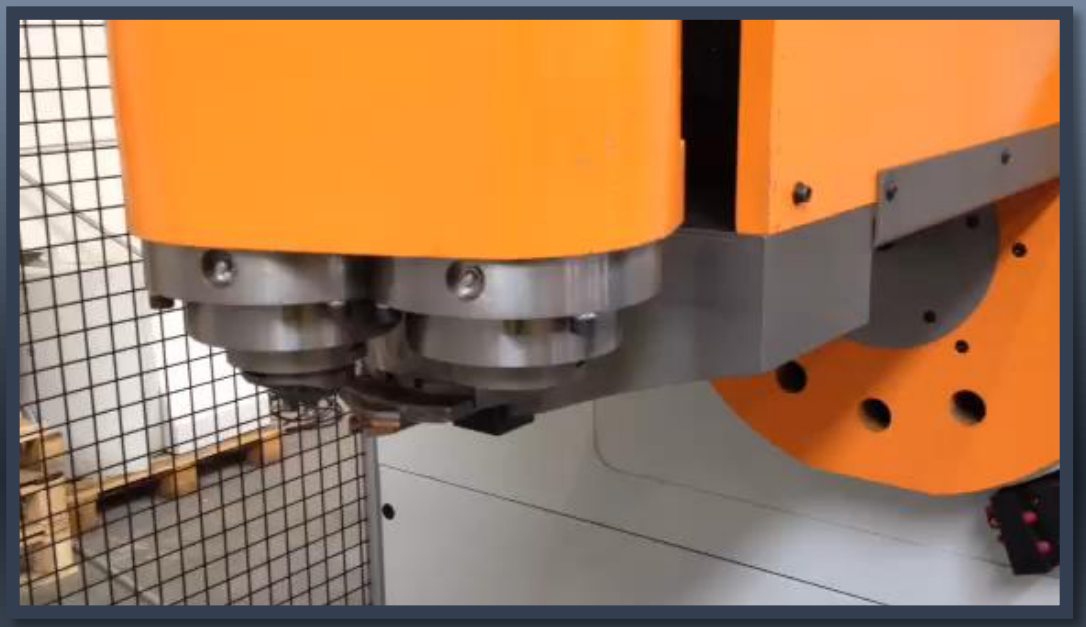
CNC ROBOT



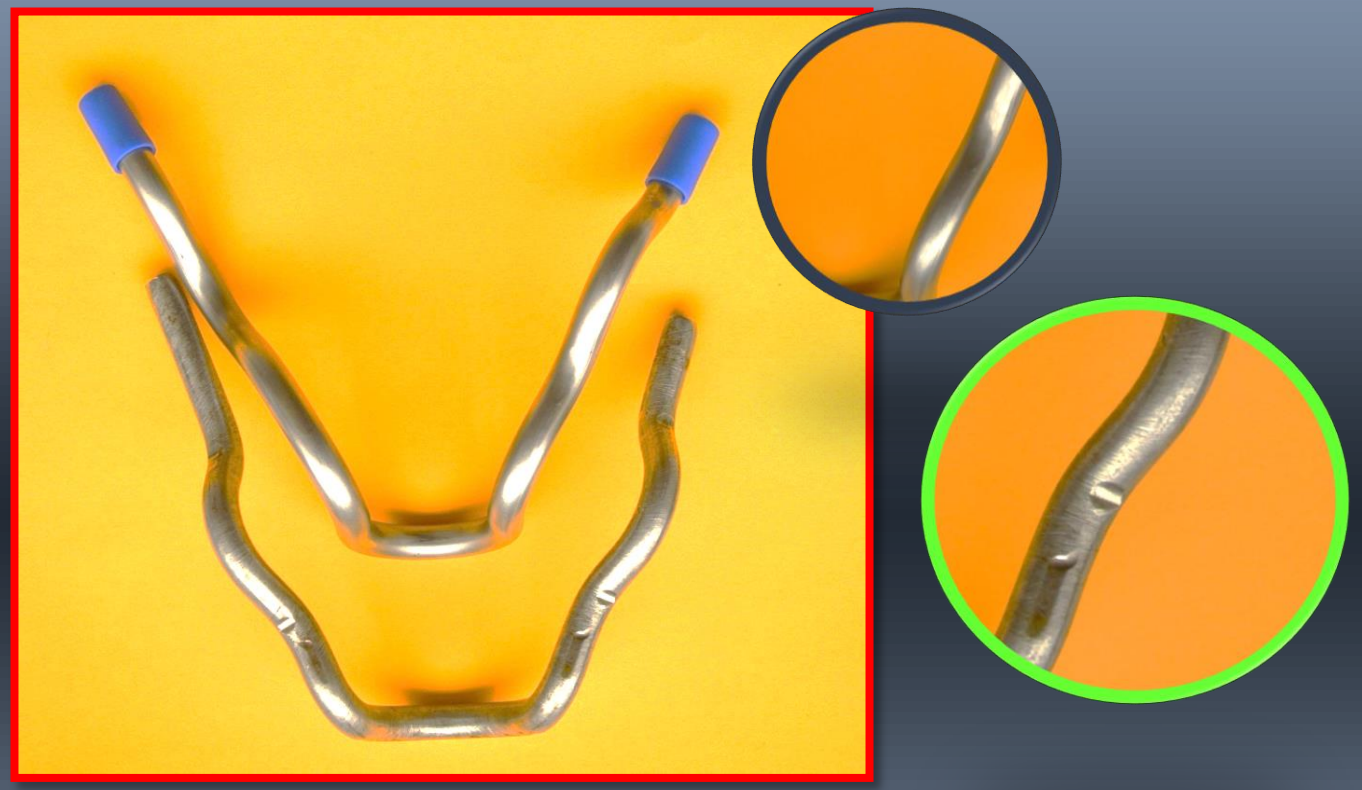
Soft bending by CNC robot using hydraulic tools

- Wire structure is more respected,
- No micro cracks formation,
- No cross section reduction,
- Regular, accurate production
- Any shape available, 3D anchors

MECHANICAL PRESS

- Large bending marks (reduction of the section, weakness points for corrosion resistance),
- Micro cracks formation at bending marks ,
- Irregular quality,
- Limited range of shapes

QUALITY PRODUCTION FOR QUALITY PRODUCTS



- Non homogeneous structure on all the length of the anchor,
- Local cross section reduction,
- Micro cracks involving a lower tensile strength resistance,
- Micro cracks opening gate for an acceleration of oxidation and corrosion

These weakness points have
an impact on the performance (life time)
of the refractory anchors …

… and then on the refractory linings

REFRACTORY ALLOYS

STANDARD Cr / Ni ALLOYS	
AISI	EN
AISI 304 - AISI 304L	1.4301 - 1.4307
AISI 309	1.4828
AISI 310S - AISI 310	1.4845 - 1.4841
AISI 314	1.4841
253MA	1.4835
Ni ALLOYS	
AISI 330	1.4864
Alloy 800 - 800H	1.4876
DS	1.4862
Alloy 601	2.4851

Oxidation

STANDARD Cr / Ni ALLOYS		
AISI	EN	**Maximun Service Temperature**
AISI 304 - AISI 304L	1.4301 - 1.4307	750°C
AISI 309	1.4828	1000°C
AISI 310S - AISI 310	1.4845 - 1.4841	1100°C
AISI 314	1.4841	1150°C
253MA	1.4835	1150°C
Ni ALLOYS		
AISI 330	1.4864	1200°C
Alloy 800 - 800H	1.4876	1200°C
DS	1.4862	1200°C
Alloy 601	2.4851	1200°C

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Grade AISI 304

- 18% of chromium, 9% of nickel
- Can be used at a maximum service temperature of 750°C

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Anchor in AISI 304 which was exposed at a temperature over 750°C involving the destruction of its steel structure (oxidation of the alloy)

Grade AISI 309

- 20% of chromium, 12% of nickel
- Can be used at a maximum service temperature of 1000°C
- Offer a good solution in case sulfur compounds in hot gases
- Intermediary solution between AISI 304 and AISI 310

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Grade AISI 310

- 25% of chromium, 20% of nickel
- Can be used at a maximum service temperature of 1100°C
- Homogeneous solution
- Most standard alloy in refractory applications

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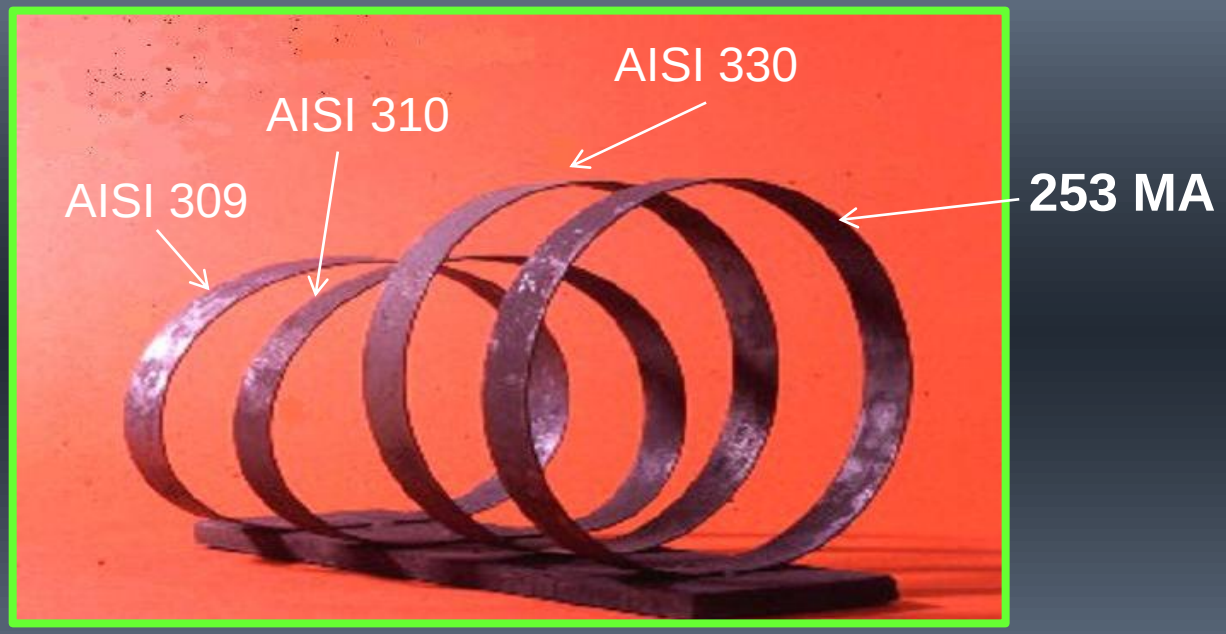
Grade 253 MA

- 21% of chromium, 11% of nickel
- Can be used at a maximum service temperature of 1150°C
- Higher creep strength than other standard alloys at high temperature,
- Good resistance to corrosion in general,
- Less sensitive to sigma phase

Nickel Alloys

- Around 35% of nickel, 25% of chromium + additives
- Solution for high temperature issue until 1200°C
- No sensitive to sigma phase
- High creep strength
- Expensive solution, availability of raw material can be a problem

CREEP DEFORMATION TEST

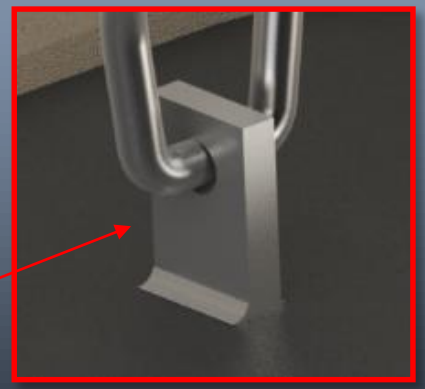


Refractory alloy strength at high temperature Creep Strength

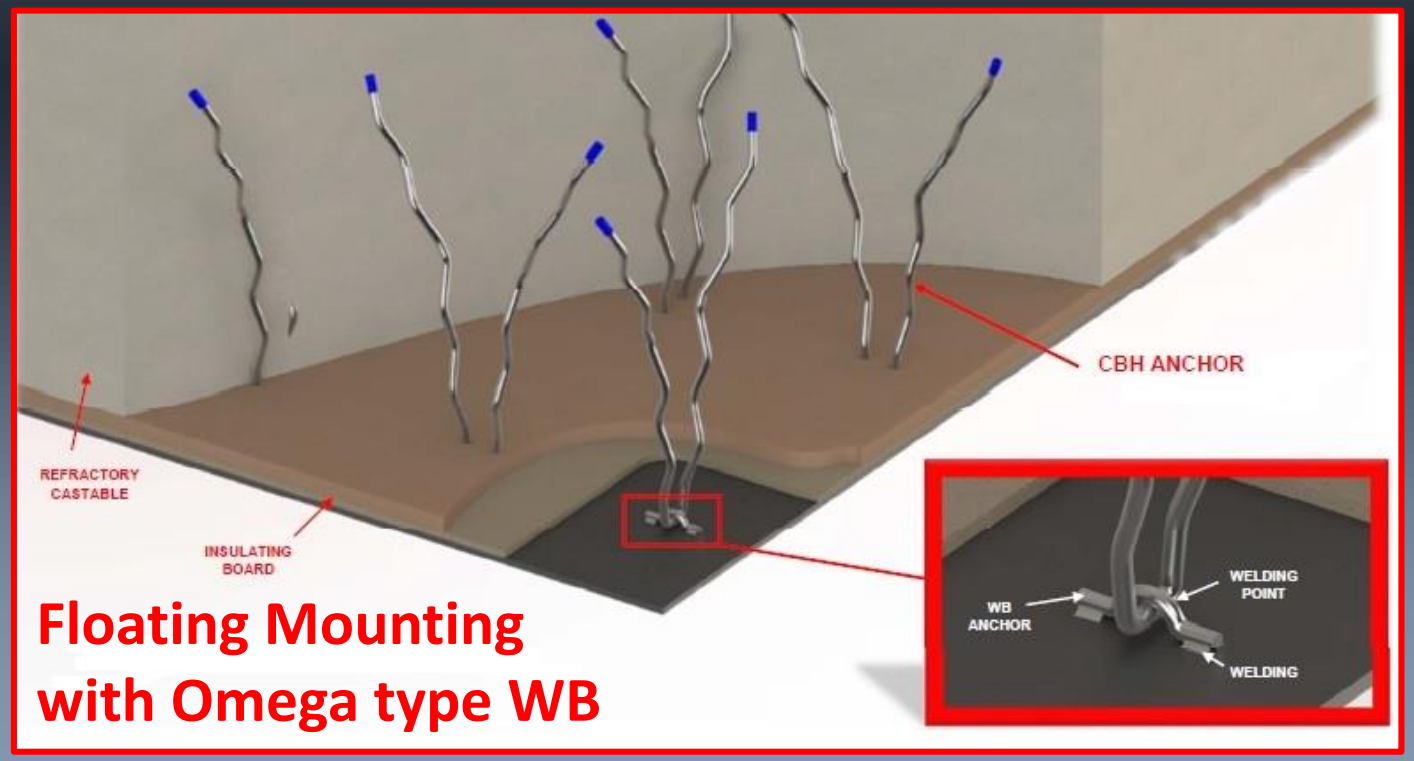
35 hours at 1000° C for alloy rings having a thickness of 1 mm
AISI 310 and AISI 309 deformed under their own weight (Creep Deformation)

Installing anchors

Stud vs stick welding



Floating mounting for dynamic applications



Floating Mounting with Omega type WB

Expansion for refractory stainless steel

- Refractory stainless steel have a higher expansion than refractory material
- Control of the expansion on the length with plastic caps

Anchors spacing

- According lining thickness
- According the weight to hold
- According the application (wall or roof section)

Questions ?

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- Section 1 – Anchor Design and Selection
- Function of Anchors
- How Anchors are Designed, Possible Shapes
- Anchor size and lining thickness
- Production of anchors and quality
- Section 2 – Using Anchors
- Alloy choice, Service Temperature, Corrosion (not in detail)
- Installing anchors (stud vs stick welding)
- Expansion allowance (plastic caps)
- Anchor spacing and pitching patterns
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- Other topics included in the day will be
- Lining thickness and thermal design
- Design at openings (nozzles etc)
- Design for installation (formwork, panelising etc)