



Testing techniques for structures inspection

29th and 30th May 2012

INTRODUCTION

DESTRUCTIVE OR SEMI-DESTRUCTIVE TECHNIQUE THAT REQUIRES SAMPLES EXTRACTION

SAMPLING:

- Cores
- · powder extraction
- broken samples from concrete structure elements









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29th and 30th May 2012

INTRODUCTION





Sampling zones must be selected according to:

- -Type of exposure (immersion, tidal zone or atmospheric)
- Exposure conditions (winds direction, exposure to rain)

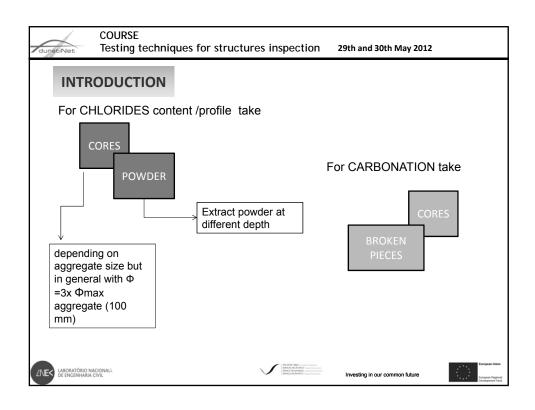
Must be supported by other techniques such as RESISTIVITY MAPS, CORROSION POTENTIAL MAPS or CORROSION RATE MAP

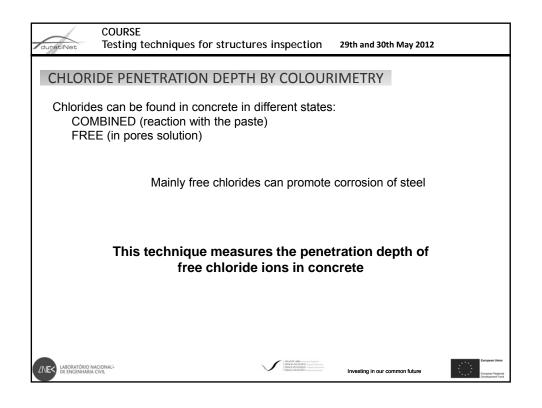




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CHLORIDE PENETRATION DEPTH BY COLOURIMETRY

Specific principle:

REACTION BETWEEN CHLORIDES AND A SOLUTION OF SILVER NITRATE

$$Ag^+ + OH^- \rightarrow AgOH$$
 Brown

$$Ag^+ + Cl^- \rightarrow AgCl$$
 White

The penetration depth is the distance between the surface and the line where the colour changes from white to brown



The method can be used to determine the presence of **free chlorides** when the amount is higher than 0.0012 % by weight of concrete





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CHLORIDE PENETRATION DEPTH BY COLOURIMETRY

Test procedure:

In a reinforced concrete structure:

- 1. Take concrete cores
- 2. Split axially into two pieces
- 3. Spray the surface with a 0.1M AgNO3 solution
- Wait 15 minutes. If chlorides are present a white silver chloride precipitate appears
- 5. Using a ruler at 10 mm interval obtain 5-7 valid depth readings
- 6. The average of the readings provide the free chloride penetration depth





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CHLORIDE PENETRATION DEPTH BY COLOURIMETRY

ADVANTAGES:

- >SIMPLE AND QUICK
- >LOW COST
- >CAN BE APPLIED IN LABORATORY TESTS AND IN SITU

REMARKS:

- ONLY INDICATIVE METHOD FOR CHLORIDE **PENETRATION**
- > IN CARBONATED CONCRETE THE REALKALINIZATION OF CONCRETE MUST BE DONE PRIOR TO THE TEST
- NOT APPLICABLE FOR CONCRETE MIXED WITH **CHLORIDES**
- > FOR IN SITU TESTS IS USEFULL TO DEFINE THE LEVEL FOR IN DEPTH CHLORIDE CONTENT DETERMINATION (PROFILE)





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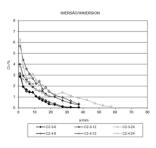
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CHLORIDE PROFILE

Determination of chloride content at different depths

THIS METHOD IS APPLICABLE FOR THE DETERMINATION OF FREE AND **TOTAL CHLORIDES**

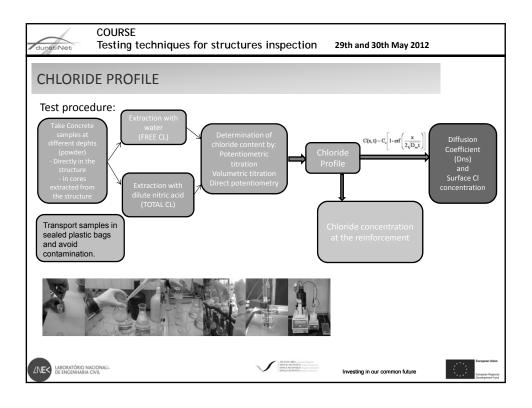
It can be obtained free chloride profile or total chloride profile depending of the method of chemical analysis

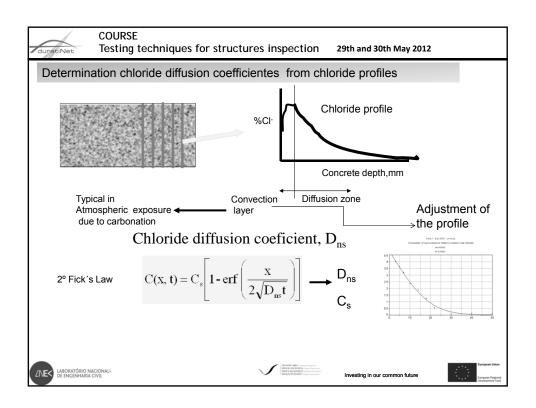


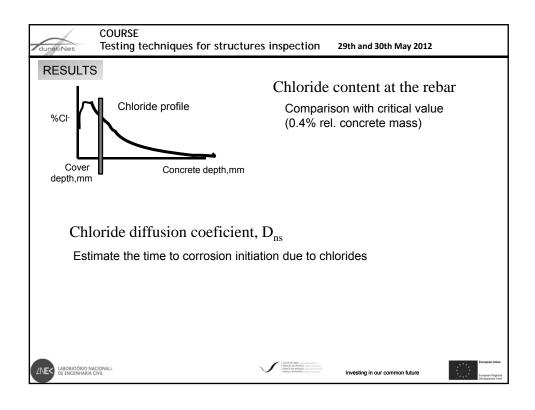


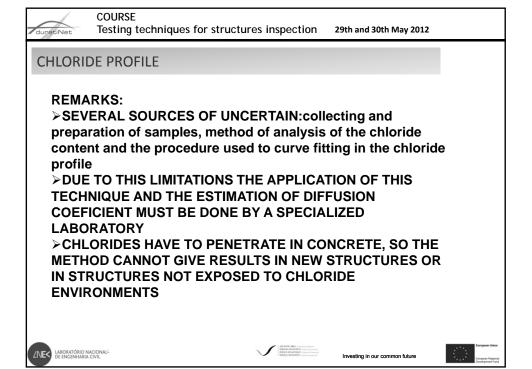














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CARBONATION DEPTH

This technique measures the penetration depth of carbon dioxide in concrete

Specific principle:

Use of pH indicators to spray in fresh fractured surfaces. The colour changes in concrete zones with different pH



pH in concrete is more than 12.5

When dioxide carbon penetrates in concrete, it reacts with calcium hidroxide and forms calcium carbonate according to the equation

$$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_20$$

In this situation pH decreases to pH values of 8-9





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29th and 30th May 2012

CARBONATION DEPTH

ADVANTAGES:

- > SIMPLE AND QUICK
- > LOW COST
- > CAN BE APPLIED IN LABORATORY TESTS AND IN SITU
 - > FOR IN SITU TESTS IS USEFULL TO DETECT IF THERE ARE CONDITIONS FOR CORROSION INITIATION IN THE REINFORCEMENT DUE TO CARBONATION





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