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Desalination: Sustainable Solutions for a Thirsty Planet

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A TECHNICAL GUIDE FOR THE REMINERALIZATION OF DESALINATED WATERS

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OBJECTIVES

1. Interpret quality of desalinated and remineralized waters.

2. Establish adequate level of remineralization within reasonable costs.

3. Present indirect method for estimating degree of remineralization based on ΔEC, pH and T.

CHAPTERS

1. Characteristics of desalinated waters.
2. Evaluation criteria.
3. Optimal levels of remineralization *(re-carbonation).*
4. Indirect calculation of LSI from ΔEC and pH.
5. Remineralization techniques.
6. Sampling procedures.
7. Simulation of different blending options.

FIELD DATA

Data from 8 desalination plants

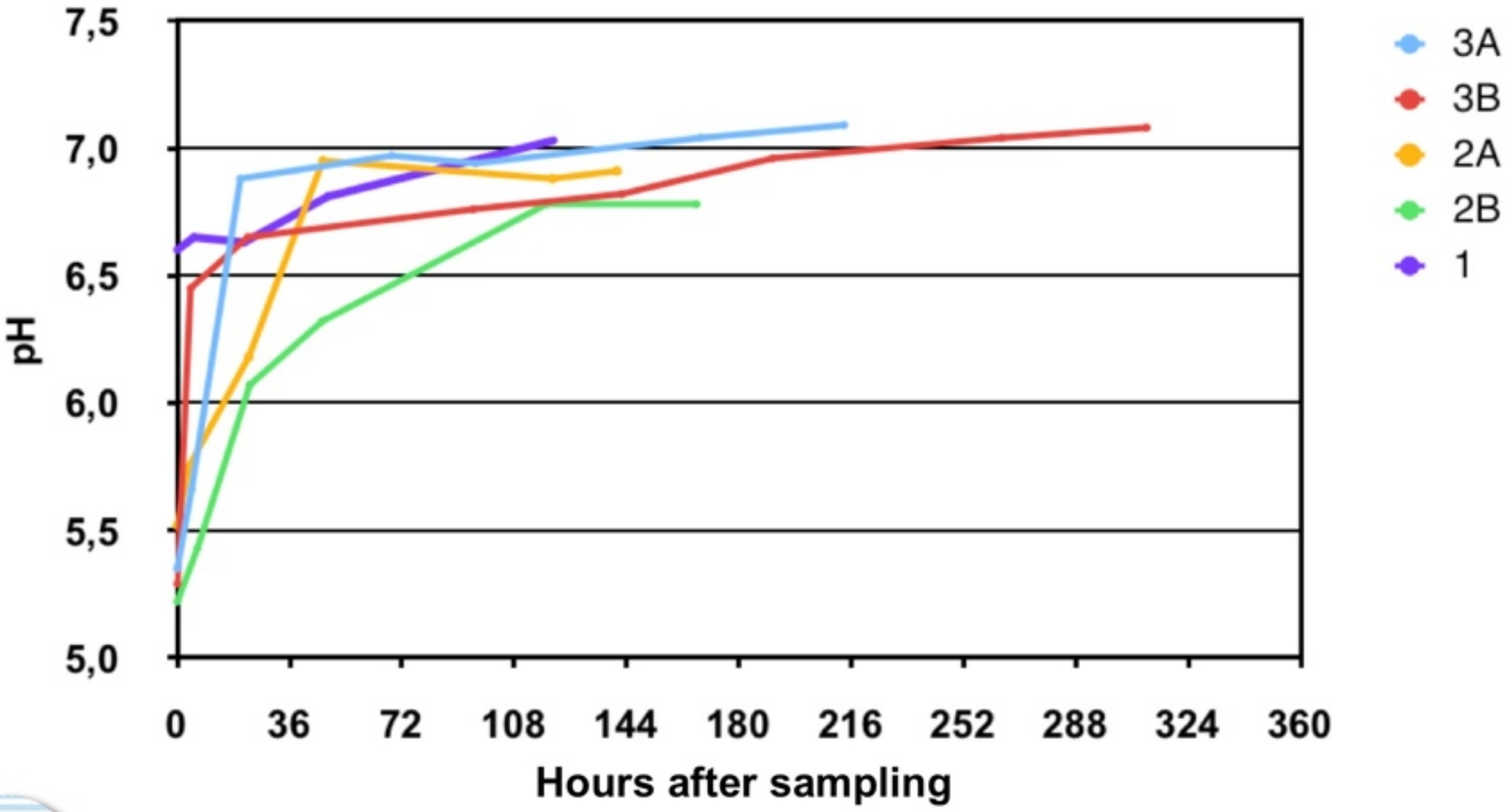
(*Spanish Mediterranean Coast*

and Canary Islands)

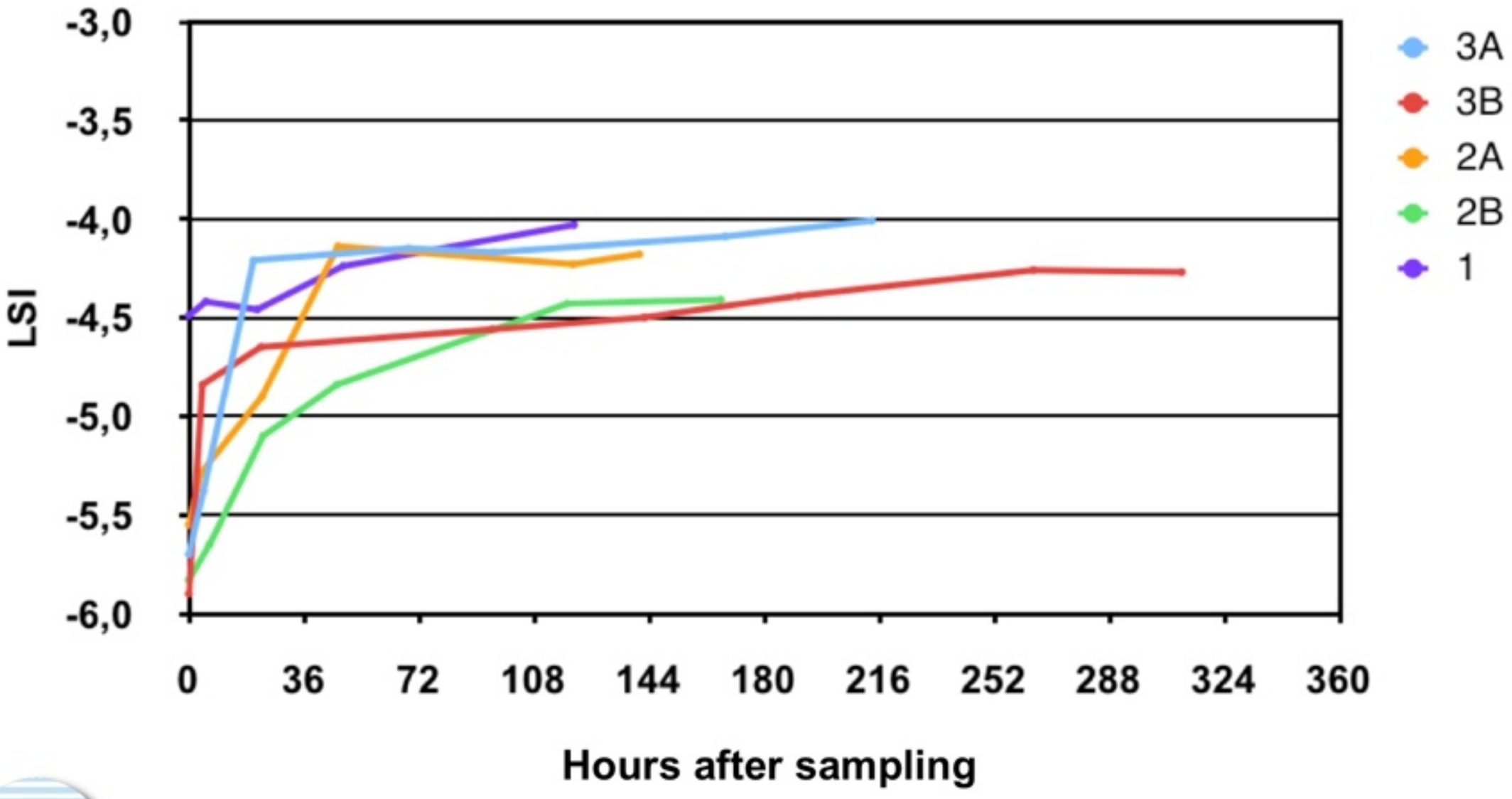
KEY ASPECTS ON DESALINATED AND REMINERALIZED WATERS:

1. Behavior of **desalinated water** in contact with **atmosphere**,
2. Need of water **postreatment**,
3. Concept of **remineralization**,
4. Behavior of **remineralized water** in contact with **atmosphere**, and
5. Adequate **level of remineralization**.

Changes in permeate pH after sampling



Changes in permeate LSI after sampling

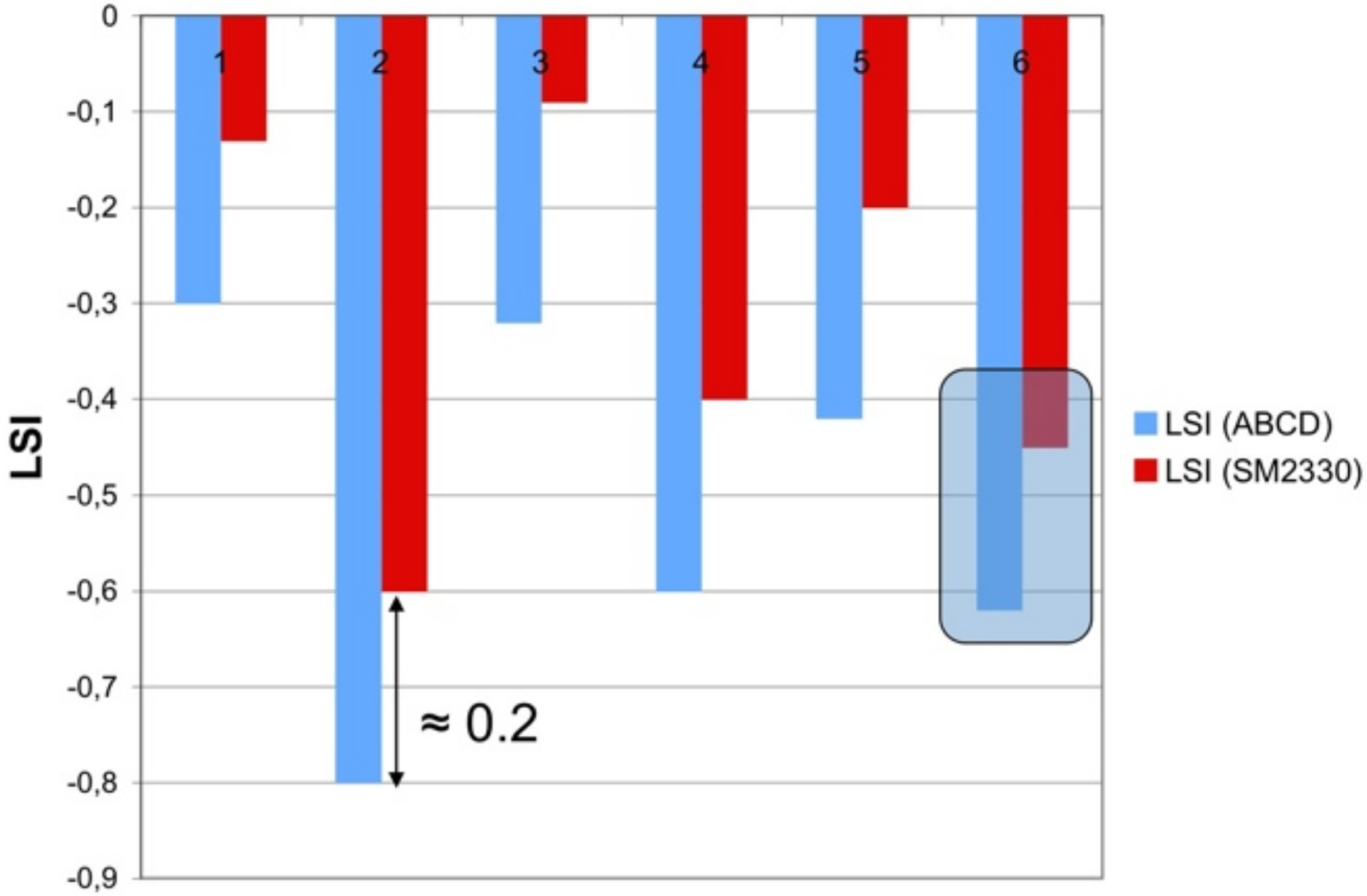


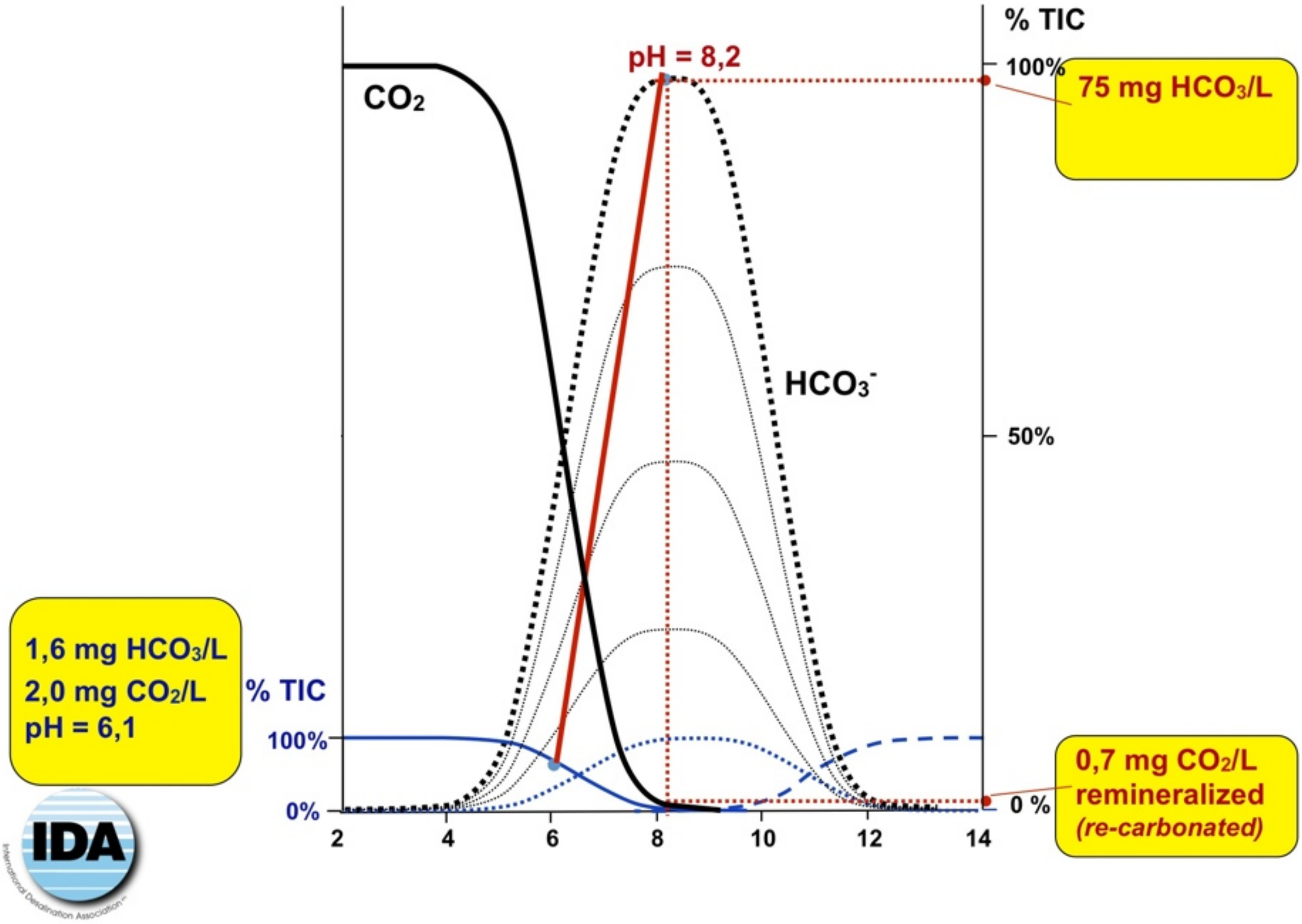
Spanish/EU Criteria

LSI ± 0.5

LSI function of: pH
temperature
TDS
Total Alk
Ca

Comparison between LSI (simplifyed) and LSI (SM 2330)




% TIC
100%
pH = 8,2
75 mg HCO3/L
CO2
HCO3-
50%
1,6 mg HCO3/L
2,0 mg CO2/L
pH = 6,1
% TIC
100%
0%
0 %
0,7 mg CO2/L
remineralized
(re-carbonated)
2
4
6
8
10
12
14

Re-carbonation reactions

Lime slurry:

$$Ca(OH)_2 + 2\,CO_2 \longleftrightarrow 2\,HCO_3^- + Ca^{+2}$$

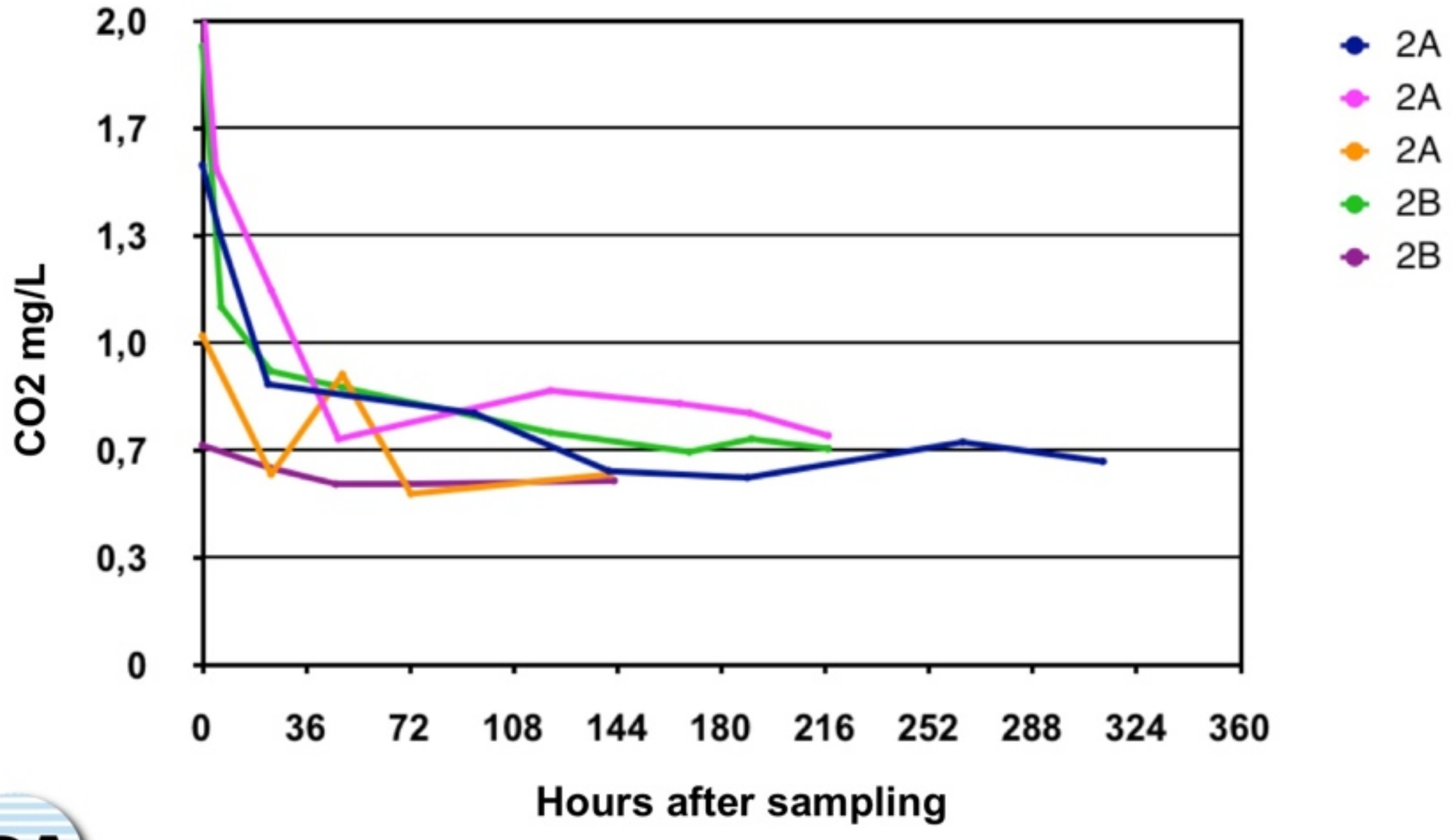
45 ppm + 54 ppm 75 ppm + 25 ppm

Limestone:

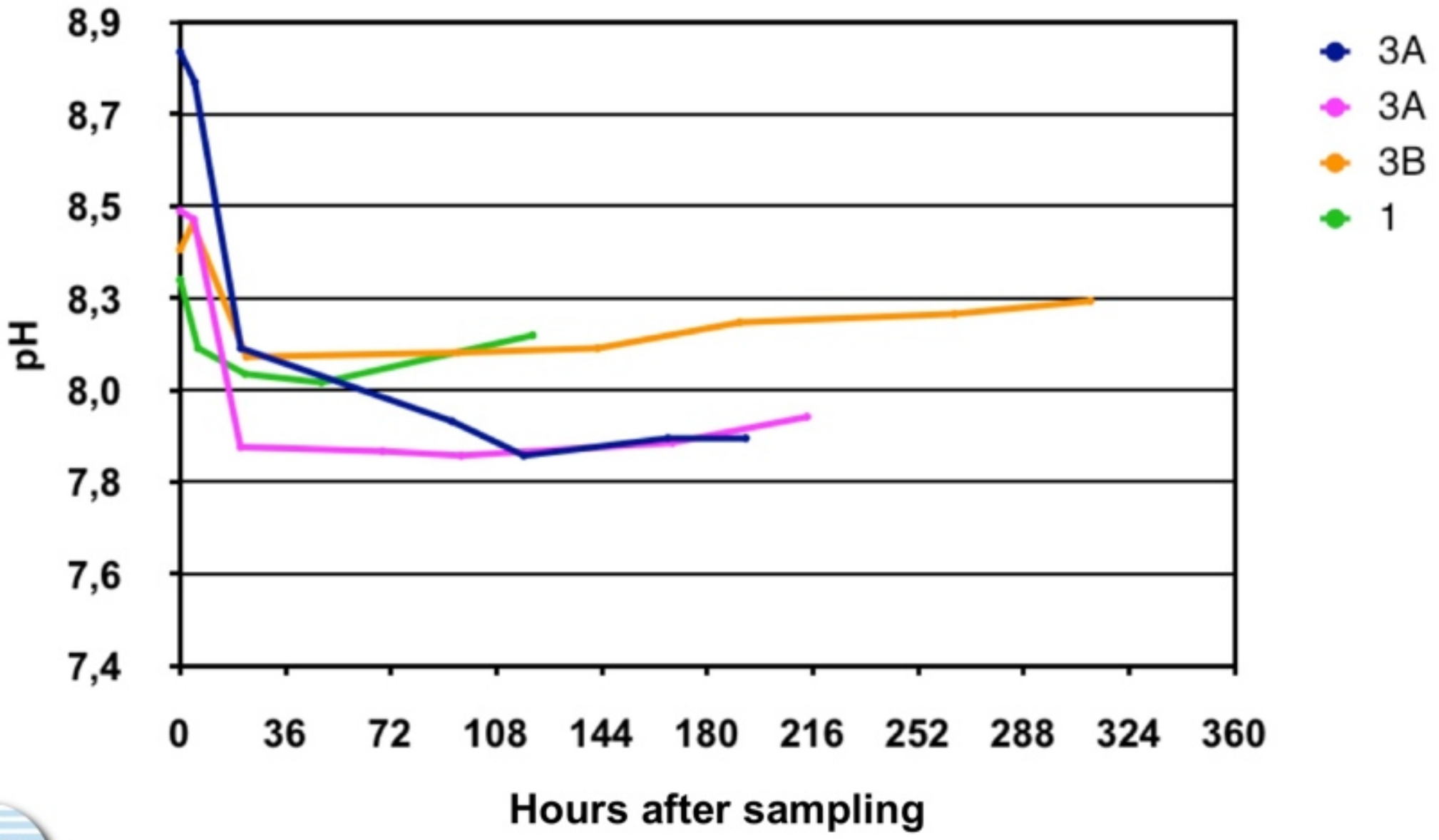
$$CaCO_3 + CO_2 \longleftrightarrow 2\,HCO_3^- + Ca^{+2}$$

61 ppm + 27 ppm 75 ppm + 25 ppm

Changes in CO_2 content after remineralization with different dose of CO_2



Changes in pH after remineralization with infradose of CO_2



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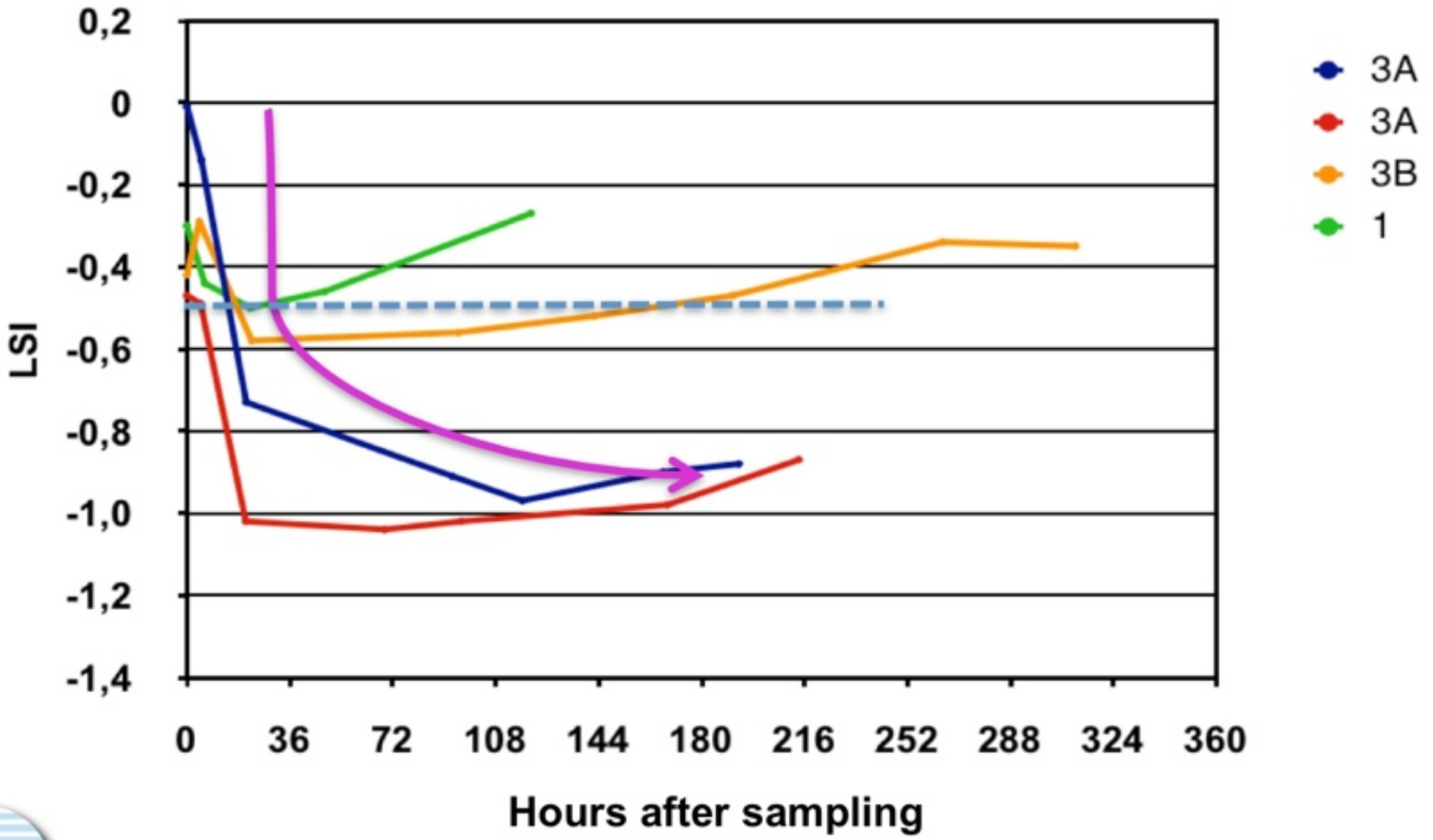
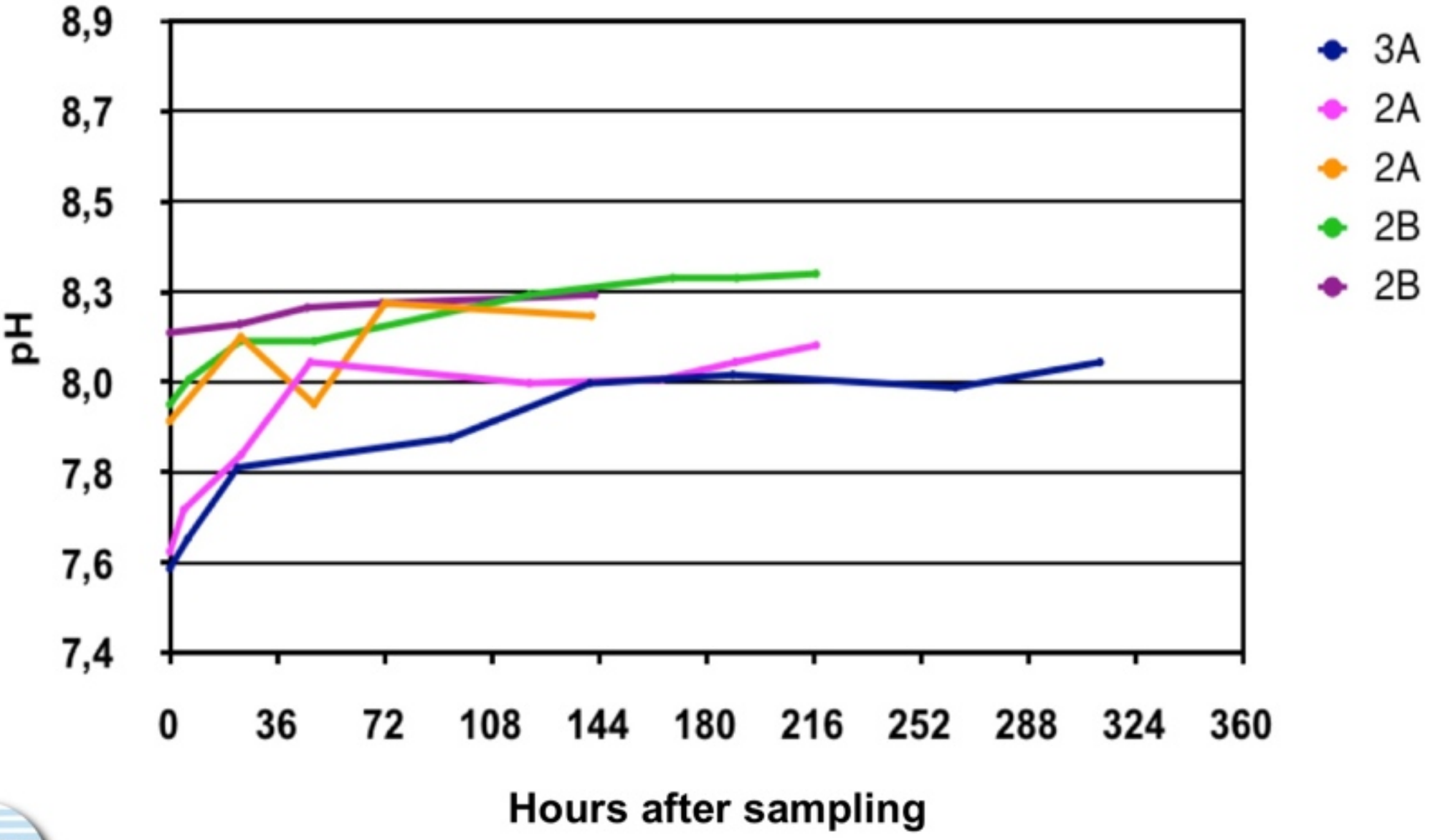
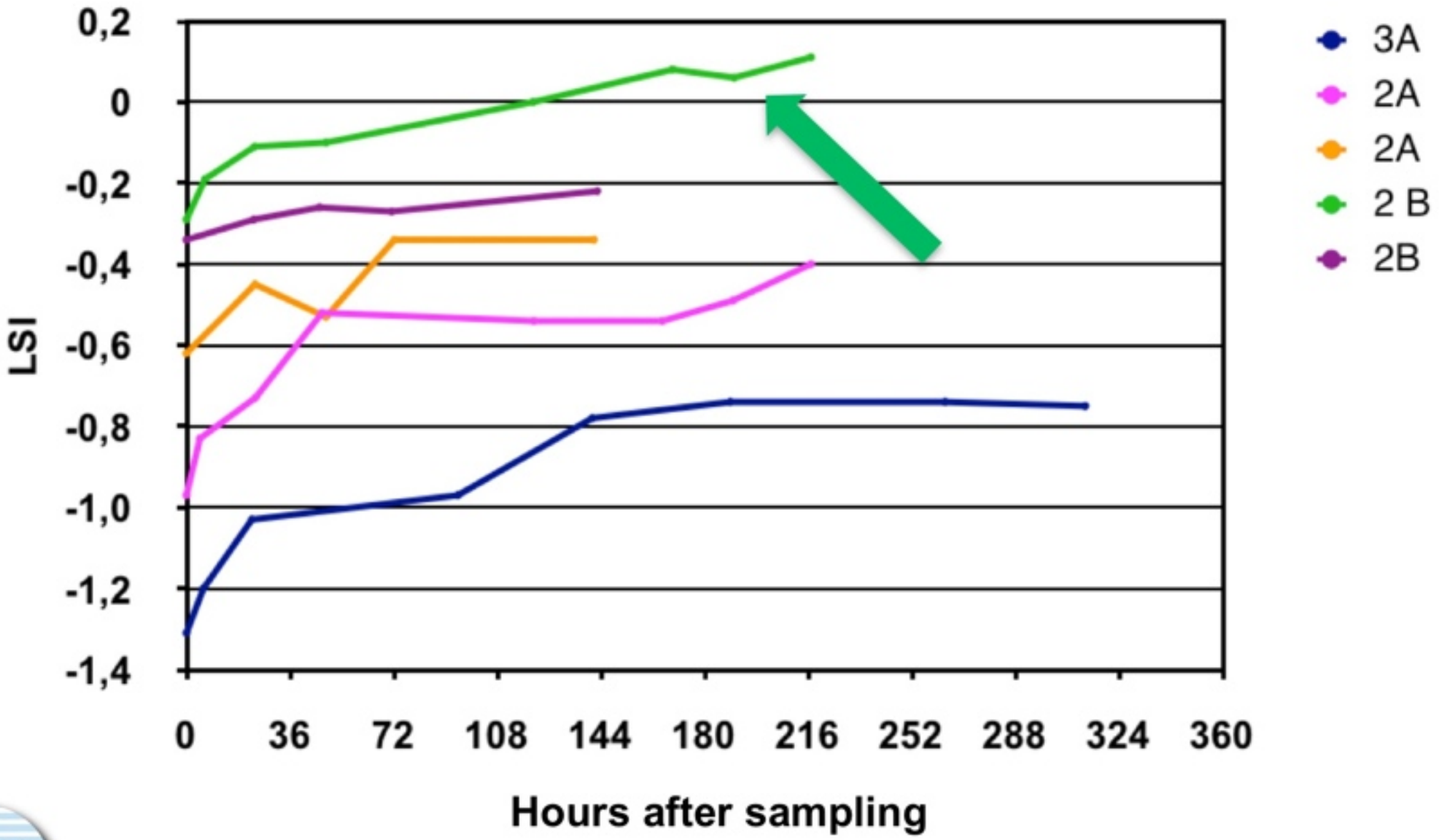
Changes in LSI after remineralization with infradose of CO_2



Changes in pH after remineralization with overdose of CO_2



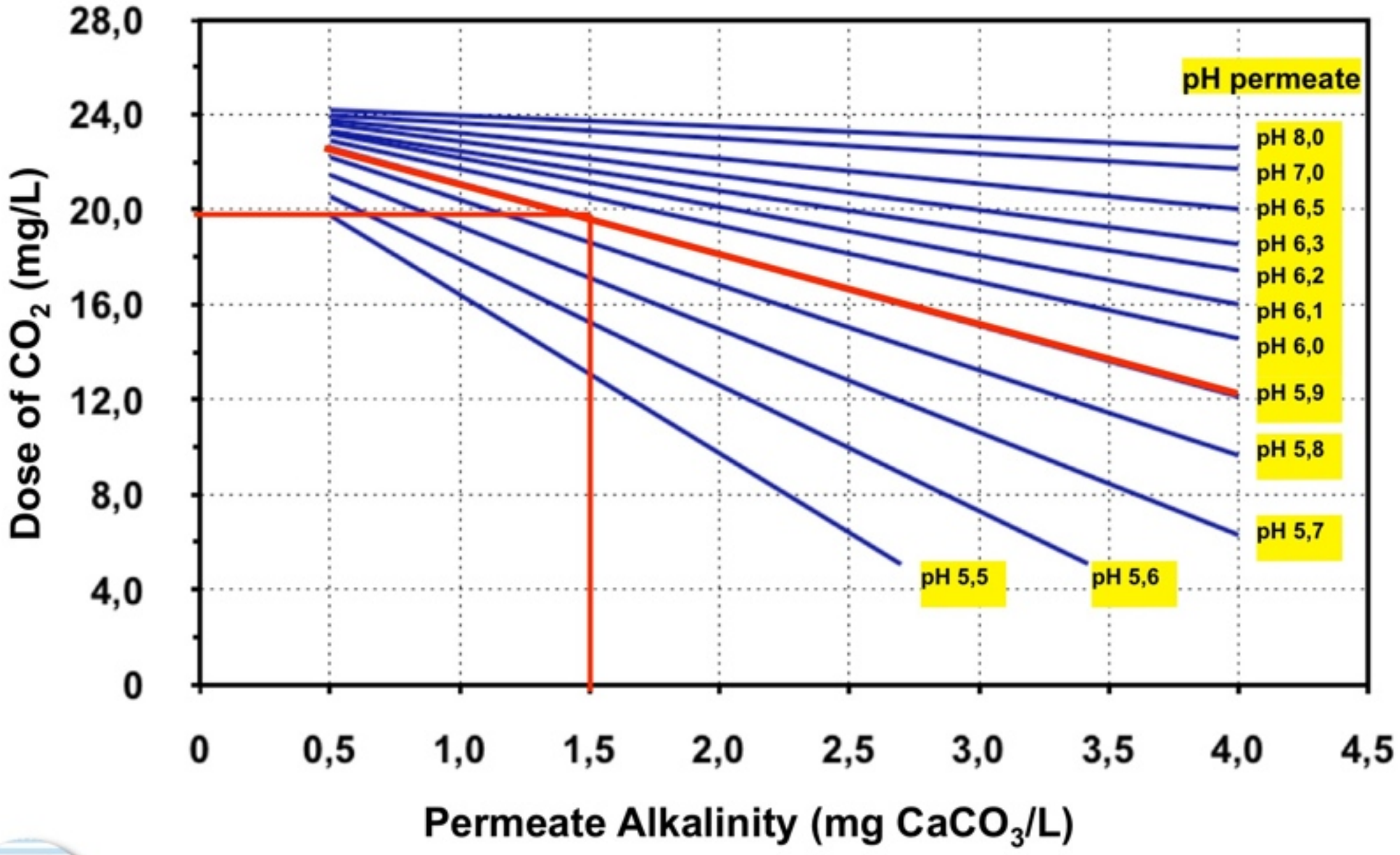
Changes in LSI after remineralization with overdose of CO_2



Adequate level of remineralization

	Before	**After**
pH	6.1	8.2 ± 0.1
Alk (mg $CaCO_3$/L)	1.3	56 ± 3
Ca (mg Ca^{2+}/L)	0.8	21 ± 2
CO_2 (mg CO_2/L)	2.0	0.7 ± 0.1
LSI	-5.2	± 0.15

CO_2 requeriments according to permeate pH and Alk
Limestone treatment



INDIRECT METHOD FOR ESTIMATING AND MONITOR THE LEVEL OF REMINERALIZATION

Measurements at the plant

pH

temperature (ºC)

electrical conductivity (EC)

LSI = f (pH, T, TDS, Alk, Ca)

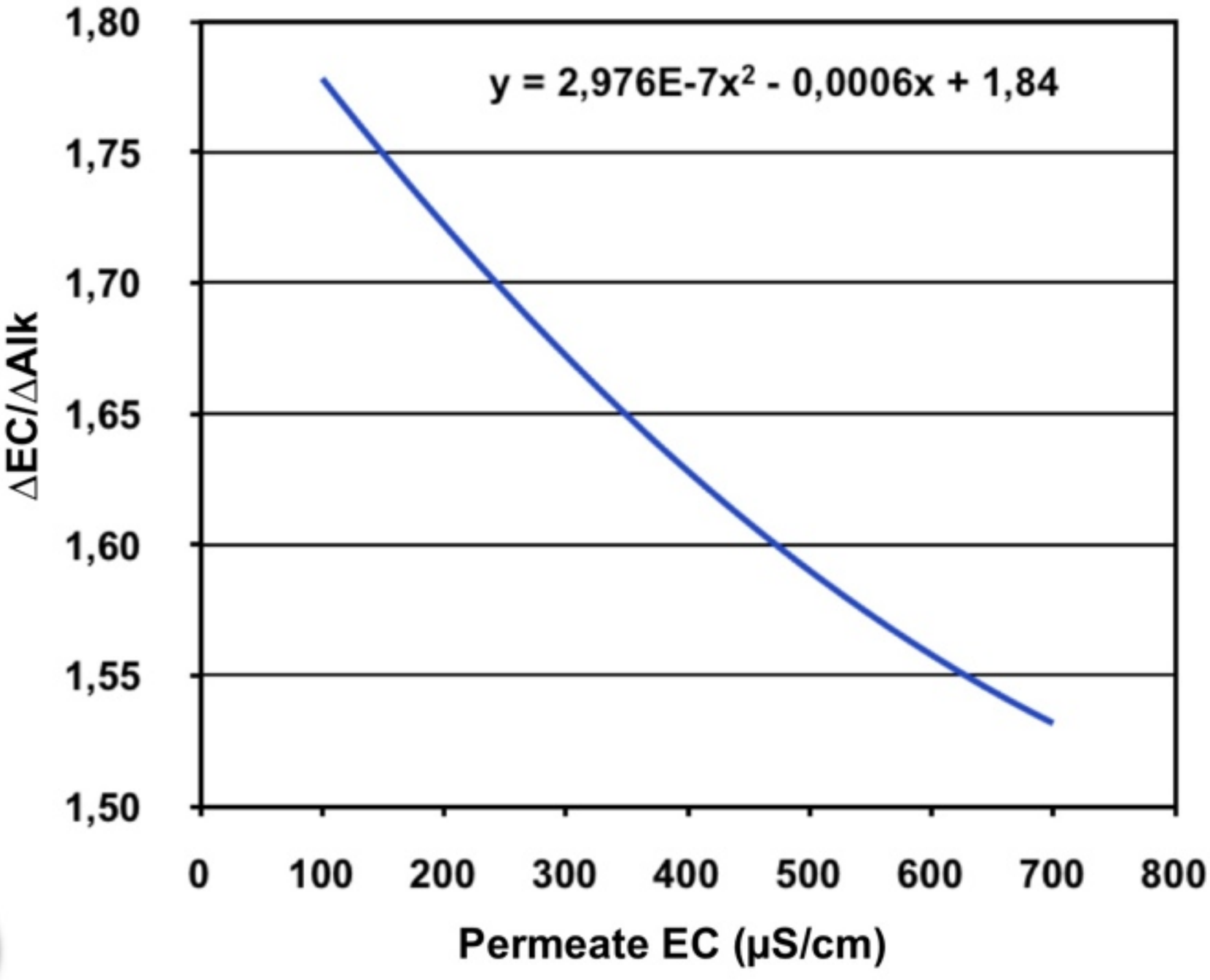
Indirect method for calculating LSI

$$TDS = 0.55\ EC_{(remineralized)}$$

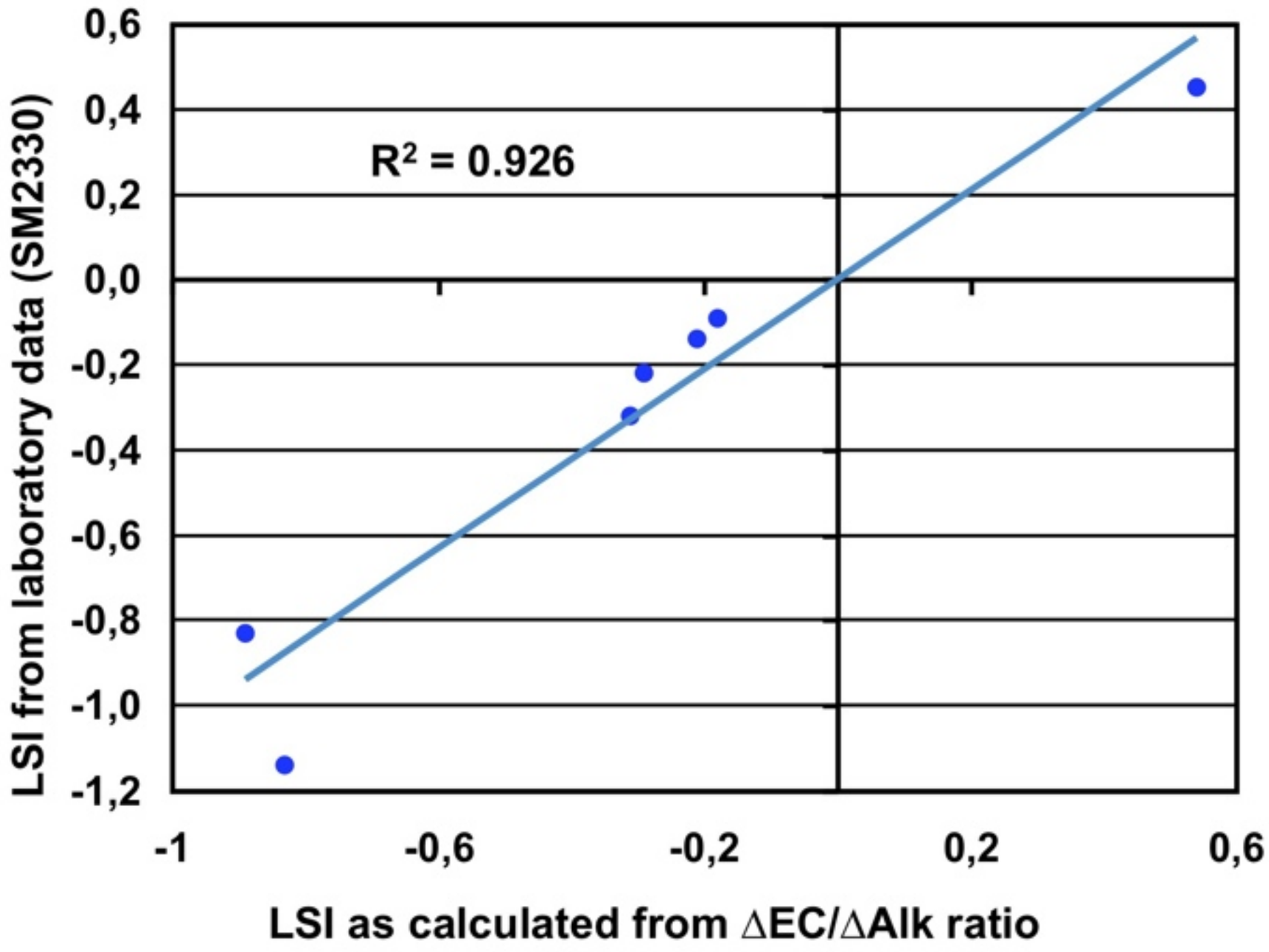
$$Ca_{(remineralized)} = \frac{Alk_{(remineralized)}}{2.5}$$

$$\frac{\Delta EC}{\Delta Alk} = 1.55 \text{ to } 1.75$$

Relationship between EC and the ratio ΔEC/ΔAlk



LSI from laboratory data and calculated from ΔEC/ΔAlk ratio



Practical tip for assessing remineralization

ΔCE should be 90 -100 µS/cm

That means:

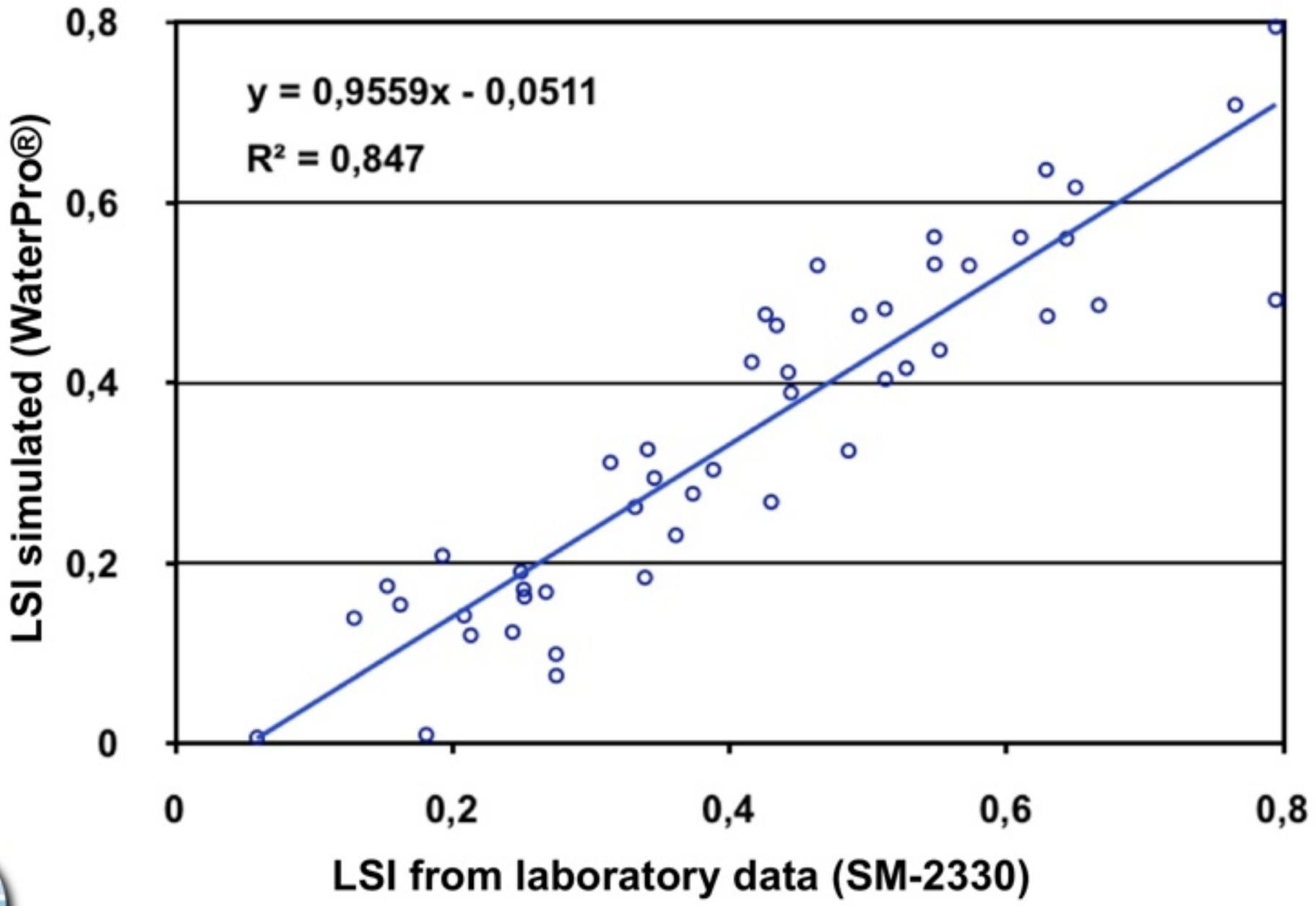
ΔAlk = 55 - 62 mg $CaCO_3$/L

pH should also be 8.2 - 8.3

Then LSI = 0.15 ± 0.05

BLENDING

Simulation of LSI for different blends using WaterPro®



CONCLUSIONS

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Important efforts devoted in the last years to solve QUANTITATIVE water problems need :

+ environmental impact minimization,

+ pretreatment and membrane optimization,

+ energy consumption minimization,

+ **qualitative water aspects.**

SUCESFULL PROCESS

acuaMed
Aguas de las Cuencas Mediterráneas

Canary Islands Water Centre

Questions

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