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TEST REPORT

Laboratory	(CH) Building Chemistry	**O/References**	DE 670X703 Labo CH 17/6959 Page 1/7
Requestor	Hydro-Bio Attn. Mr. van de Werve Rue du Tilleul 15 B-6210 Les Bons Villers		
Contact	BBRI - Mrs. P. Steenhoudt		
Date of the order	January 2017	**Samples registration nr.**	/
		Date of reception of samples	/
Date of issue of the report	07 04 2017 – English translation of the French report dated 22 03 2017		
Tests carried out	Assessment of the effective capacity of a water treatment system type **SoluCalc O12** to reduce the formation of scale deposits in a domestic hot water installation		
References	EVACODE procedure, developed by the laboratory CH		

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- ☐ *No sample*
- ☑ *Sample(s) subjected to destructive test*
- ☑ *Sample(s) to be removed from our laboratories 30 calendar days after sending of the report, save in the case of a further written request.*

Technical assistance « Building Chemistry »	Head of laboratory «Building Chemistry »
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1. OBJECTIVE OF THE TEST

The objective of the test is to assess the effective capacity or the ability of a water treatment device, type **SoluCalc O12,** to reduce the scale deposition in a domestic hot water installation. This is done by submitting the apparatus to a test method developed in the laboratory which reproduces actual use conditions.

2. DESCRIPTION OF THE TESTED APPARATUS

The tested device is of the type **SoluCalc 012** from the company **Hydro-Bio**. This apparatus consists of an automated injection device which injects a controlled amount of carbon dioxide (CO_2) in the water distribution circuit in order to limit the formation of calcium- and magnesium carbonate, commonly called scale or limestone.

This device is illustrated below:

❶ Le SoluCalc 012
❷ Le manodétendeur de gaz et son tuyau
❸ Alimentation électrique en 12V
❹ En option: le pHmètre et sa solution étalon
❺ La chaînette de sécurité pour la bouteille de CO_2
❻ Le mode d'emploi
❼ Le kit régulateur de pression 1" & vanne
❽ En option: Raccords vers tuyaux PVC, cuivre ou acier

3. TESTS AND MEASURES

3.1 Principle of the EVACODE test method

The test method for this evaluation was developed by the laboratory 'Building Chemistry' (Evacode project - Convention Bureau of standards CC CCN/PN/NBN-917).

This method evaluates the effectiveness of an anti-scale water treatment device by comparing the amount of scale deposits, formed by treated and untreated water, whereby hardened water is transported simultaneously into two individual and independent sanitary water circulation systems, called test stations.

Each test station includes the following:

- *a particle filter*
- *a water inlet and outlet meter*
- *solenoid valves*
- *an electric water heater system (comprising a transparent cylinder acting as the heater reservoir), with a reservoir capacity of 15 litres, including an electrical resistance in stainless steel and a temperature sensor*
- *a water circulator*

Test station A includes the tested device placed immediately downstream of the meter and upstream of the heater/boiler, whereby test station B is the reference.

Tap water distributed in the two test stations is enriched in a controlled manner with sodium bicarbonate and calcium chloride in order to make the water more capable to scaling. Subsequently it is distributed simultaneously to test stations A and B.

The experimental conditions are described below:

- *Water temperature: ± 60°C*
- *Daily water consumption: 130 litres (with a regular input of fresh water in volumes of 5 to 10 litres during 16 hours, and a stagnation period of 8 hours)*
- *Test duration: 21 days*
- *Total water consumption: ± 2.7* m^3

3.2 Effective capacity assessment

After 21 days of hot water production, each test station is shut off and drained. The water heater is removed and brought to the laboratory. The deposits present on the sides and on the bottom of the water heater reservoir and the electrical resistance is recovered quantitatively. Each fraction is dried at 45 ° C and weighed. The sum of the masses obtained for the two test stations (M_A and M_B) is compared and the fraction below (called E factor) can be considered as an expression of the effective capacity or the ability of the tested equipment to reduce the limestone deposition:

$$\text{E factor} = (M_B-M_A)/M_B*100$$

3.3 Characterization of limestone deposits

The two crystallographic forms mainly present in the deposits formed within boiler systems are calcite and aragonite, both composed of calcium carbonate ($CaCO_3$). It is possible to distinguish these two crystallographic forms by X-ray diffraction (XRD). Both figures below, obtained by XRD analysis, illustrate the very different diffractogrammes of pure calcite and pure aragonite.

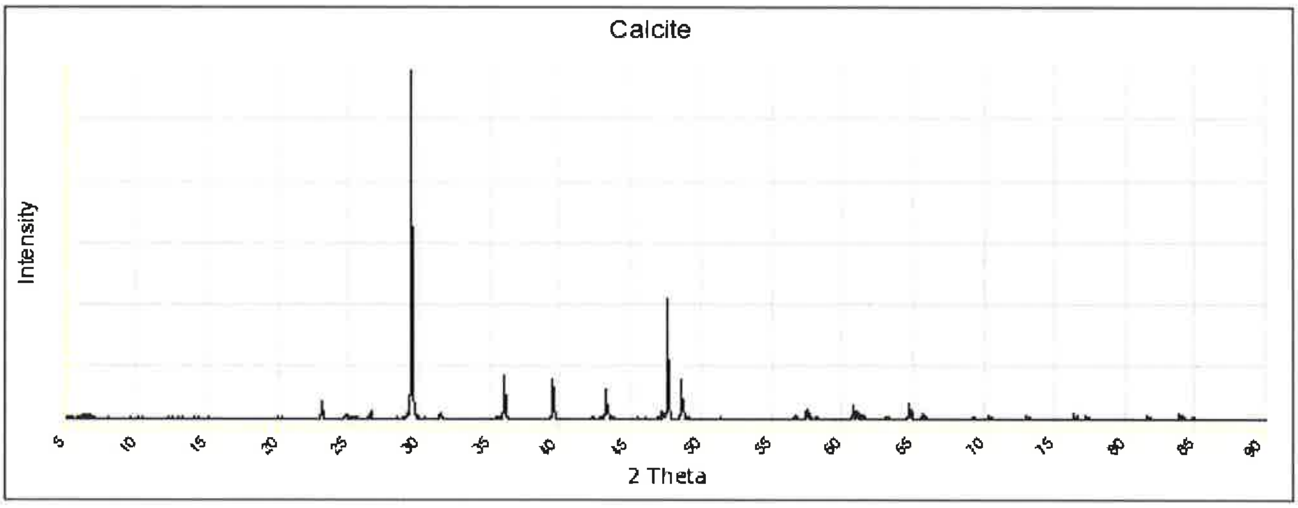

Figure 1 : *XRD spectrum of calcite*

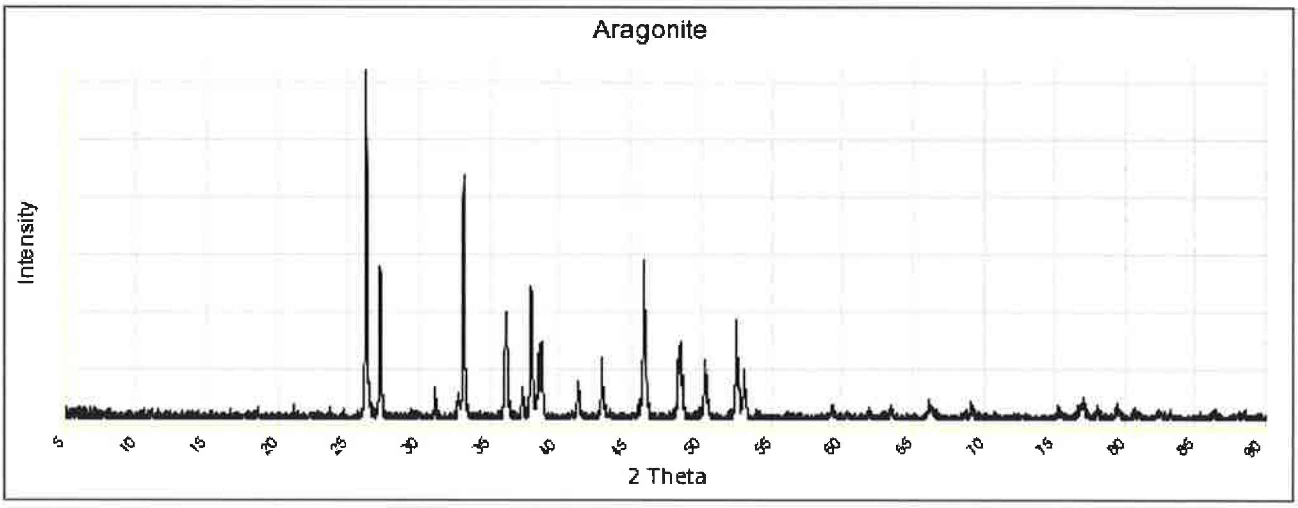

Figure 2 : *XRD spectrum of aragonite*

4. RESULTS

4.1 Effective capacity assessment

The table below shows the dry masses of deposits taken from the sides and the bottom of the boiler reservoir, and the electrical resistance of the two water heaters. The effective capacity of the tested device is evaluated from these data.

Removal zone	**Collected dry mass (g)**		**Illustration**
	Station A	**Station B**	
sides	4.94	55.55	Cfr. picture 1
bottom	4.05	6.31	Cfr. picture 2
resistance	21.55	41.26	Cfr. picture 3
Total	**$M_A = 30.54$ g**	**$M_B = 103.12$ g**	
Effective capacity **E factor = $(M_B-M_A)/M_B*100 = 70$ %**			

Table 1: *Effective capacity of the tested device*

Test station A
SoluCalc O12

Test station B
(reference)

Picture 1
Deposits taken from the sides of the reservoir

Picture 2
Deposits taken from the bottom of the reservoir

Picture 3
Deposits taken from the electrical resistance

4.2 Characterization of the collected limestone deposits

The deposits collected on the electrical resistance of the two water heaters are analysed by x-ray diffraction. The obtained spectra are included in figures 3 and 4 below.

In both cases, the material is predominantly calcium carbonate, in the form of aragonite. During this relatively short test (21 days), the formed deposits do not show significant difference in their crystallographic form.

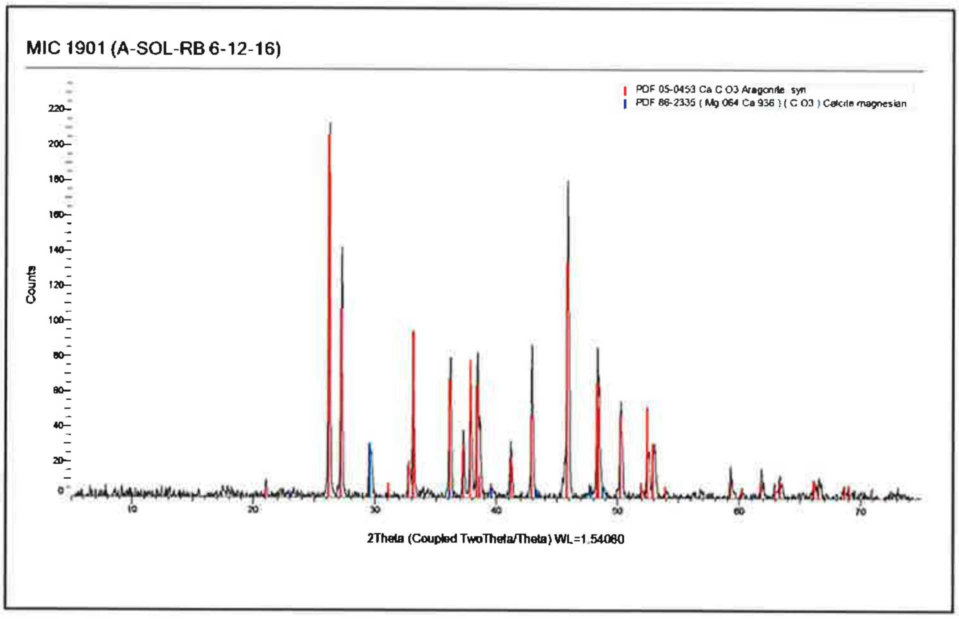

Figure 3 : *XRD spectrum of the deposits taken on the electrical resistance of test station A*

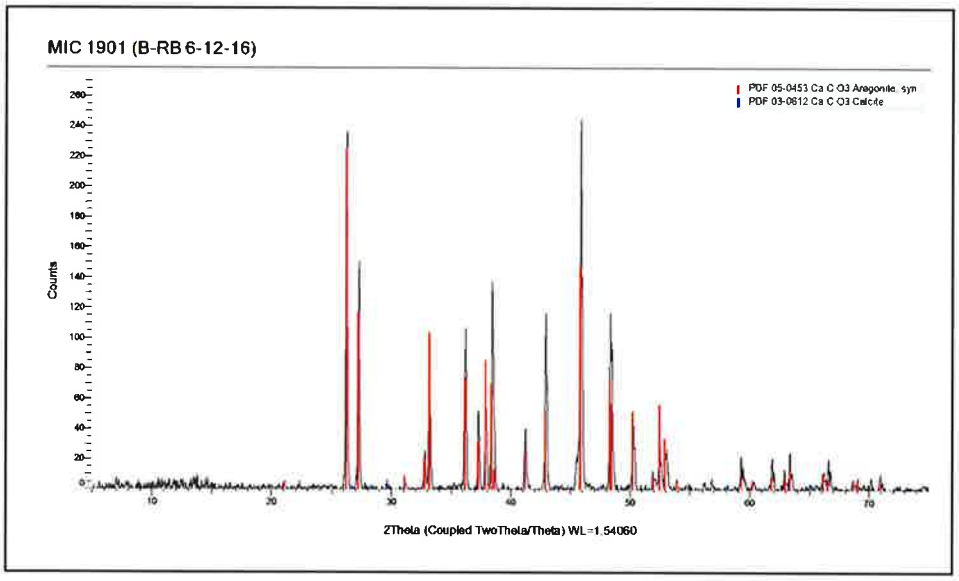

Figure 4 : *XRD spectrum of the deposits taken on the electrical resistance of test station B*

5. CONCLUSION

Subjected to the test conditions of the evaluation test of the effective capacity of anti-scale devices for installation of domestic hot water (EVACODE test), the device **SoluCalc O12** of the company **Hydro-Bio** helped **reduce the formation of limestone deposits** within a water heater with water at 60 ° C **for at least 70%**. Moreover, the deposits formed predominantly on the electrical resistance, which favors the formation of calcium carbonate scale given its high temperature. In comparison with the case of untreated water, nearly no deposits (< 10 %) have formed on the colder reservoir sides of the heater.

Based on these initial results, we believe that a test performed on a longer time scale (e.g. 3 months) could more accurately assess the performance of the device and could possibly demonstrate its ability to eliminate already formed calcareous deposits.

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