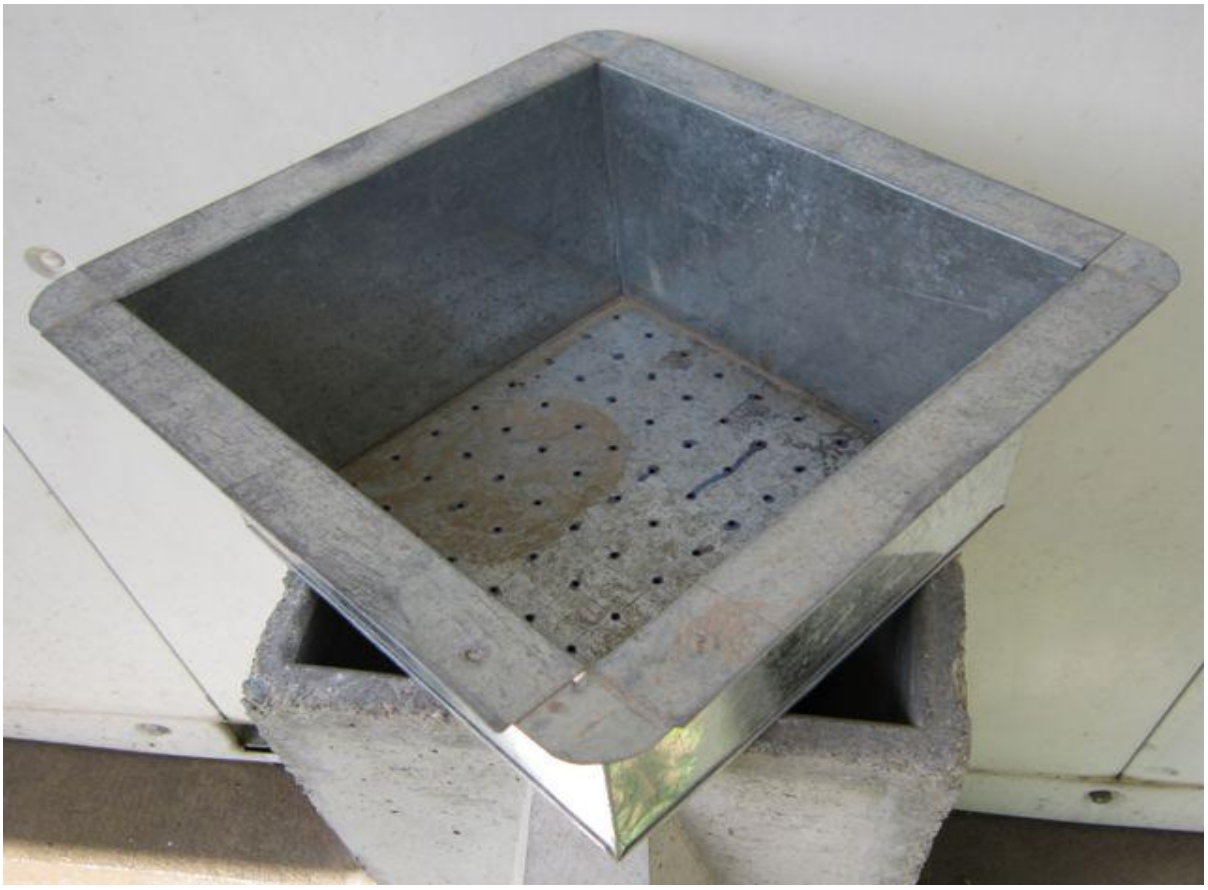
DACAAR

WATER EXPERTISE AND TRAINING CENTRE

Action Research on Effect of Numbers and Sizes of Holes in Diffuser Basin on Sand layer and Biolayer



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1. INTRODUCTION

The function of the diffuser is to avoid any disturbance of the sand surface and bio-layer when water is added to the top of the bio-sand filter. It is essential for the correct operation of the bio-sand filter so that pathogens do not infiltrate far into the sand bed.

There are several types of diffusers that can be built, each with its own advantages and limitations. The one that you choose to build will depend on your skill level, the tools and materials that are available, cost, and the preference of the users.

It was observed in few evaluations conducted by DACAAR that many times the sand layer and bio-layer were disturbed, of which real cause was unknown to some extent, but the size and number of holes were assumed to be cause of these disturbances. Therefore, it was essential to test the different diffuser boxes and plate with different sizes and number of holes in diffusers to identify the suitable size and number of holes for diffuser box.

1.1 Research Question:

Do the sizes and numbers of holes in a diffuser basin have an affect on the disturbances of sand layer and biolayer?

1.2 Objectives:

1. To identify the effect of sizes and numbers of holes in a diffuser basin on the sand layer and biolayer disturbances.

2. To identify the effect of the sizes and numbers of the holes in a diffuser basin on emptying of filter reservoir.

2. METHODOLOGY

1. Twelve biosand filters were fabricated and installed in place with easy access to source water to be monitored regularly and water to be put into it timely. Therefore, they were installed in DACAAR's Eastern Regional Office, Jalalabad, Nangarhar.

2. Twelve diffuser basins were made with holes sized 1 mm, 2 mm, 3 mm and 4.5 mm and each of them with number of 36 holes, 81 holes and 144 holes.

3. Each filter had serial number and against the number all relevant information was recorded in readymade format.

4. A responsible person was assigned and was pouring water into the filters at least three times a day, observing the changes in sand layer, recording potential changes on relevant forms of each filter and taking photos of sand layer of each filter once a day. Preferably early morning.

5. Emptying time of each filter reservoir was recorded on specific form made for each filter.

3. ANALYSIS

The analysis was carried out by observing the sand layers by direct observation and recorded by responsible person and shared with researcher and advisor.

4. REQUIREMENTS

A number of items were needed to ensure that the project could work. Various components were required to ensure that all work could be done properly. By making sure that all items and resources were available the project could generate enough reliable data to make it possible to get a satisfactory outcome.

4.1 Personnel

One responsible person poured water into the filters at least three times a day, observed the sand layer, recorded the changes, made the photos and recorded the emptying time of filters' reservoir as well.

4.2 Resources

1. Twelve filters of version 10 installed with proper filter media
2. Twelve diffuser basins with hole sizes 1 mm, 2 mm, 3 mm and 4.5 mm and each of them with holes number of 36 holes, 81 holes and 144 holes.
3. Water containers for each filter that were big enough to contain the required water.
4. A camera was available to make photos of set-up and sand layer every day to keep the record of changes occurring in sand layer.
5. The forms for recording were available in hard copy for each filter.
6. Sending all the forms and photos were done with the computer in the field office or the regional office.

5. PROCESSES AND PROCEDURES

1. All filters were labelled with numbers that were clearly marked in English.
2. The marking was done with un-deletable ink and when getting faint was relabelled. Initial marking was done with paint, as that lasted longer than writing with felt pen.
3. The size and numbers of the hole were written at inside of the reservoir to identify the diffuser basin type (size and number of holes).
4. For each filter with a specific diffuser basin a format was made, while both filters and form had the same identification numbers
5. The responsible person was trained on how to observe the filter sand layer, make records, take photos and to put the results of the observations an excel sheet.
6. The water was poured into the filter at least three times a day.
7. Photos were taken early morning before water was poured into the filters and uploaded to computer on a daily basis.

6. FINDINGS

6.1 Early Changes:

Early changes and disturbances in sand layer occurred in the biosand filters installed with diffuser basin that had holes size 3 mm diameter,4.5 mm diameter and 2 mm diameter with holes numbers of 36, and diffuser basin that had holes size 4.5 mm diameter with hole numbers 144. These changes and disturbances occurred during the first week of research and remained the same with not easily visible changes to the end of the research.

6.1.1 Late Changes:

Late changes and disturbances occurred in the biosand filters installed with diffuser basin holes sized 4.5 mm diameter with number of holes 81, holes sized 3 mm diameter with numbers of holes 81, and holes size 3 mm diameter with number of holes 144. These changes and disturbances occurred during the second week of research and again remained the same with not easily visible changes to the end of the research.

6.1.2 No Changes:

No considerable changes and disturbances in sand layer occurred in the biosand filters installed with diffuser basin that had holes size 1 mm diameter with number of holes 36, 81 and 144, and holes size 2 mm with number of holes, 81 and 144 as well.

6.1.3 Obvious Changes:

Obvious changes and disturbance occurred in filter installed with diffuser basins that had holes size 2 mm diameter, 3mm diameter and 4.3 mm diameter with hole number 36, and in filter installed with diffuser basin that had hole size 4.5 mm diameter with hole numbers 144.

6.1.4 Small Changes:

Small changes and disturbance were occurred in filter installed with diffuser basins holes size 3 mm diameter with holes numbers 81 and 144, and hole size 4.5 mm diameter with hole number 81.

7. EMPTYING TIME OF DIFFUSER BASIN

The emptying time of a diffuser basin is the time in which the diffuser basin or reservoir get emptied. The purpose of measuring emptying time of diffuser basin was to identify whether there was any difference between this time among different diffuser basins that had different holes in numbers and sizes. So if this time was longer, then the user will get tired for waiting to add another round of the water into the filter. There was not much difference in emptying time among all types of the basins; see the average emptying time in table below:

S #	Diffuser Basin	Average Emptying Time in Minutes
01	Holes number 36 and size 1 mm	82
02	Holes number 36 and size 2 mm	93
03	Holes number 36 and size 3 mm	86
04	Holes number 36 and size 4.5 mm	89
05	Holes number 81 and size 1 mm	72

06	Holes number 81 and size 2 mm	98
07	Holes number 81 and size 3 mm	85
08	Holes number 81 and size 4.5 mm	85
09	Holes number 144 and size 1 mm	52
10	Holes number 144 and size 2 mm	62
11	Holes number 144 and size 3 mm	53
12	Holes number 144 and size 4.5 mm	56

8. DISCUSSION:

The correct hole numbers and sizes in diffuser basins which did not disturb the biolayer and sand layer were size 1 mm diameter with holes number 36, 81 and 144 and size 2 mm diameter with number of holes 144. But to make hole sizes 1 mm diameter it is difficult and even not possible with nails, therefore it needed a special drill with blade of 1 mm diameter, even though with this drill that was also too complicated as the blade kept breaking very quickly. The second correct size was 2 mm diameter with 81 and144 holes which was possible with drill and nail to make holes.

9. CHALLENGES:

Making 1mm holes in diffuser basins was difficult as the drill bits broke very quickly. Making of photos and understanding the changes occurring in the sand layer over time was difficult to be judged properly as there was always a shadow of something due to standing water on the sand layer. Furthermore, it was also difficult to understand the changes occurred in sand layer form photos, especially if the changes were small in sand layer.

10. CONCLUSION:

The small hole size with more numbers of holes will not disturb the sand layer and biolayer substantially.

Early and Obvious Changes		Late and small Changes		No Changes	
Holes #	Holes size	Holes #	Holes size	Holes #	Holes size
36	2 mm	81	3 mm	36	1 mm
36	3 mm	81	4.5 mm	81	1 mm
36	4.5 mm	144	3 mm	144	1 mm
144	4.5 mm			81,144	2 mm

11. RECOMMENDATIONS:

Based on aforementioned discussion the recommended size of holes are 1-3 mm in diameter with hole numbers of 81-144. The size 1 mm diameter of holes is better than 2 mm diameter and 2 mm is better than 3 mm and above the size of 3 mm diameter is not recommended. *Here by a basin with hole size 2 mm with holes number 100-144 is strongly recommended*

12. ANNEXES

12.1 Formats

12.1.1 Basin with holes sized 1 mm diameter

Date	**Holes # 36**	**Holes # 81**	**Holes # 144**
	Sand layer condition	**Sand layer condition**	**Sand layer condition**
5.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
6.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
7.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
8.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
9.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
10.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
11.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
13.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
15.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
16.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
17.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
19.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
20.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
20.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
23.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
25.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
26.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
27.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
28.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
29.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
30.9.12	No obviously visible changes	No obviously visible changes	No obviously visible changes
1.10.12	No obviously visible changes	No obviously visible changes	No obviously visible changes

12.1.2 Basin holes sized 2 mm diameter

Date	**Holes # 36**	**Holes # 81**	**Holes # 144**
	Sand layer condition	**Sand layer condition**	**Sand layer condition**
5.9.12	Small changes	No considerable changes	No considerable changes
6.9.12	Small and diffused changes	No considerable changes	No considerable changes
7.9.12	Small and diffused changes	No considerable changes	No considerable changes
8.9.12	Small and diffused changes	No considerable changes	No considerable changes
9.9.12	Small and diffused changes	No considerable changes	No considerable changes
10.9.12	Small and diffused changes	No considerable changes	No considerable changes
11.9.12	Small and diffused changes	No considerable changes	No considerable changes
13.9.12	Small and diffused changes	No considerable changes	No considerable changes
15.9.12	Small and diffused changes	No considerable changes	No considerable changes
16.9.12	Small and diffused changes	No considerable changes	No considerable changes
17.9.12	Small and diffused changes	No considerable changes	No considerable changes
19.9.12	Small and diffused changes	No considerable changes	No considerable changes
20.9.12	Small and diffused changes	No considerable changes	No considerable changes
20.9.12	Small and diffused changes	No considerable changes	No considerable changes
23.9.12	Small and diffused changes	No considerable changes	No considerable changes
25.9.12	Small and diffused changes	No considerable changes	No considerable changes
26.9.12	Small and diffused changes	No considerable changes	No considerable changes
27.9.12	Small and diffused changes	No considerable changes	No considerable changes
28.9.12	Small and diffused changes	No considerable changes	No considerable changes
29.9.12	Small and diffused changes	No considerable changes	No considerable changes
30.9.12	Small and diffused changes	No considerable changes	No considerable changes
1.10.12	Small and diffused changes	No considerable changes	No considerable changes

12.1.3 Basin with holes sized 3 mm diameter

Date	**Holes # 36**	**Holes # 81**	**Holes # 144**
	Sand layer condition	**Sand layer condition**	**Sand layer condition**
5.9.12	Obvious and diffused changes	No considerable changes	No considerable changes
6.9.12	Obvious and diffused changes	No considerable changes	No considerable changes
7.9.12	Obvious and diffused changes	No considerable changes	No considerable changes
8.9.12	Obvious and diffused changes	No considerable changes	No considerable changes
9.9.12	Obvious and diffused changes	No considerable changes	No considerable changes
10.9.12	Obvious and diffused changes	No considerable changes	No considerable changes
11.9.12	Obvious and diffused changes	No considerable changes	No considerable changes
13.9.12	Obvious and diffused changes	No considerable changes	No considerable changes
15.9.12	Obvious and diffused changes	Small changes	No considerable changes
16.9.12	Obvious and diffused changes	Small changes	Small changes
17.9.12	Obvious and diffused changes	Small changes	Small changes
19.9.12	Obvious and diffused changes	Small changes	Small changes
20.9.12	Obvious and diffused changes	Small changes	Small changes
20.9.12	Obvious and diffused changes	Small changes	Small changes
23.9.12	Obvious and diffused changes	Small changes	Small changes
25.9.12	Obvious and diffused changes	Small changes	Small changes
26.9.12	Obvious and diffused changes	Small changes	Small changes
27.9.12	Obvious and diffused changes	Small changes	Small changes
28.9.12	Obvious and diffused changes	Small changes	Small changes
29.9.12	Obvious and diffused changes	Small changes	Small changes
30.9.12	Obvious and diffused changes	Small changes	Small changes
1.10.12	Obvious and diffused changes	Small changes	Small changes

12.1.4 Basin with holes sized 4.5 mm diameter

Date	**Holes # 36**	**Holes # 81**	**Holes # 144**
	Sand layer condition	**Sand layer condition**	**Sand layer condition**
5.9.12	Small and diffused changes	No considerable changes	Obvious and diffused changes
6.9.12	Obvious and diffused changes	No considerable changes	Obvious and diffused changes
7.9.12	Obvious and diffused changes	No considerable changes	Obvious and diffused changes
8.9.12	Obvious and diffused changes	No considerable changes	Obvious and diffused changes
9.9.12	Obvious and diffused changes	No considerable changes	Obvious and diffused changes
10.9.12	Obvious and diffused changes	No considerable changes	Obvious and diffused changes
11.9.12	Obvious and diffused changes	No considerable changes	Obvious and diffused changes
13.9.12	Obvious and diffused changes	No considerable changes	Obvious and diffused changes
15.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
16.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
17.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
19.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
20.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
20.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
23.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
25.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
26.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
27.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
28.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
29.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
30.9.12	Obvious and diffused changes	Small changes	Obvious and diffused changes
1.10.12	Obvious and diffused changes	Small changes	Obvious and diffused changes

12.2 Photos

Figure 1: Obvious changes hole # 36 with 3 mm size

Figure 2: Obvious changes hole # 36 with 4.5 mm size

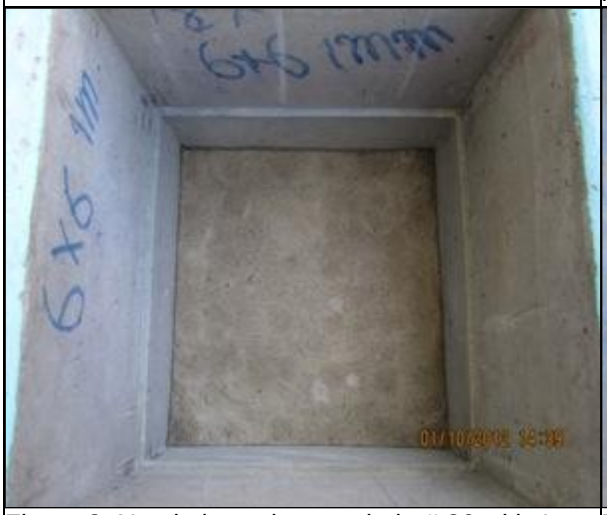

Figure 3: No obvious changes hole # 36 with 1mm size

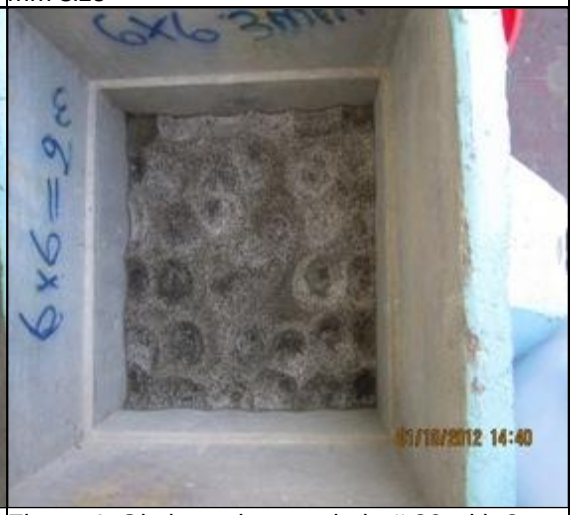

Figure 4: Obvious changes hole # 36 with 2 mm size

Figure 5: Fine changes hole # 144 with 3 mm size

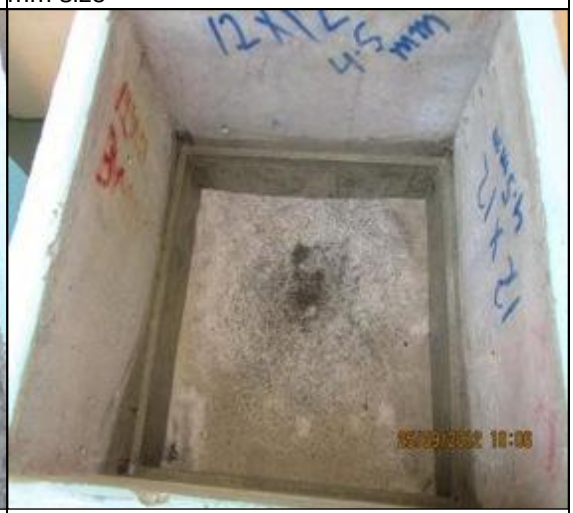

Figure 6: Obvious changes hole # 144 with 4.5 mm size

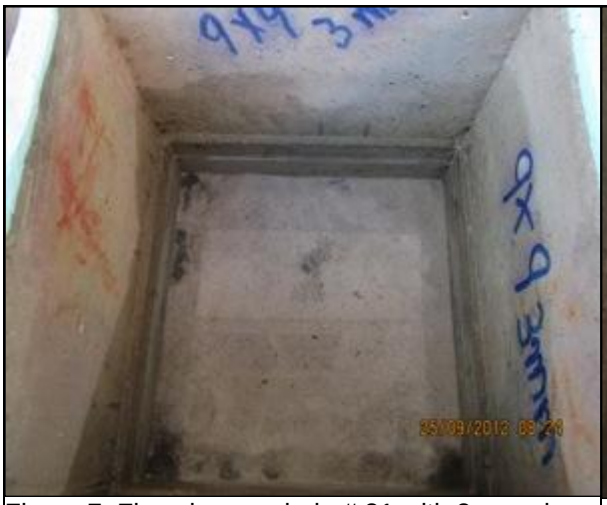

Figure 7: Fine changes hole # 81 with 3 mm size

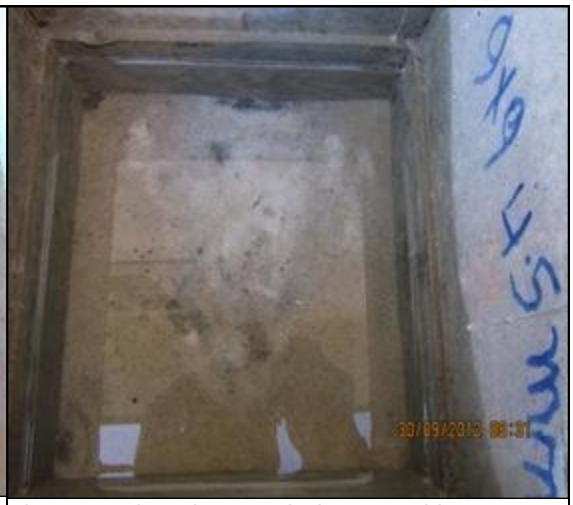

Figure 8: Fine changes hole # 81 with 4.5 mm size

Figure 9: N o obvious changes hole # 81 with 2 mm size

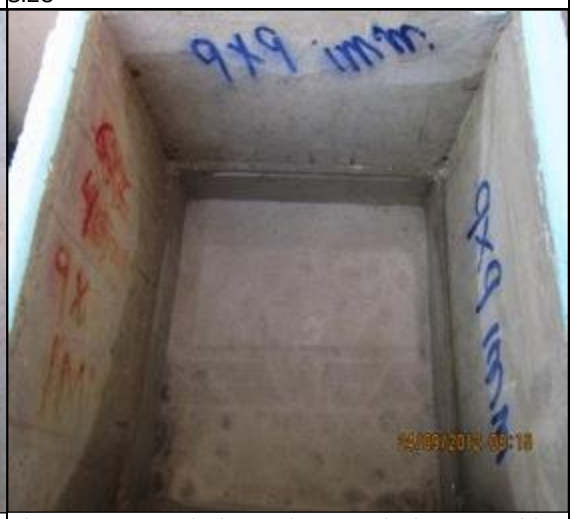

Figure 10: No obvious changes hole # 81 with 1 mm size

Figure 11: No obvious changes hole # 144 with 2 mm size

Figure 12: No obvious changes hole # 144 with 1 mm size