



## CASE STUDY

Saronno Hospital, Milano, Italy

Medical Public hospital, since 2011



# Table of contents

## **1. ABSTRACT.**

## **2. AIR CONTAMINATION IN HOSPITALS: INTRODUCTORY CONCEPTS**

## **3. THE CHARACTERISTICS OF THE BIOREACTORS OBJECT OF EXPERIMENTATION**

3.1. INTRODUCTION

3.2. MODE OF OPERATION OF BIOREACTORS OBJECT OF EXPERIMENTATION: INTRODUCTORY CONCEPTS

3.3. THE WINNING FEATURES OF BIOREACTORS OBJECT OF THE TESTING

## **4. TEST: AREAS, TYPE OF CAP UNITS USED AND MONITORING TECHNIQUES**

4.1. Introduction

4.2. General Info

4.3 The area of testing

4.3 The cap installed

4.4. Monitoring techniques applied: detection tools

## **5. PRESENTATION OF RESULTS: SUMMARY**

5.1. Introduction

5.2. Reduction of bacterial colonies

5.2.1. Introduction

5.2.2. Reduction of bacterial colonies: summary of results obtained in room 1

5.2.3. Reduction of bacterial colonies: summary of results obtained room 2

5.2.4. Reduction of bacterial colonies: summary of results obtained in room 3

5.2.5. Reduction of bacterial colonies: summary of results obtained in room 4

5.3. Reduction of airborne particles (particulate matter)

5.3.1. Introduction

5.3.2. Reduction of airborne particles: summary of results obtained room 1

5.3.3. Reduction of airborne particles: summary of results obtained room 2

5.3.4. Reduction of airborne particles: summary of results obtained in room 3

5.3.5. Reduction of airborne particles: summary of results obtained in room 4

## **6. CONCLUSIONS**

# 1. Abstract.

This document has been prepared to present in summary form the main data obtained in the experiment:

1. carried out to verify the operation of stand-alone bioreactors, referred to as CAP-600 and CAP-85 (Clean Air Plant™) and, in particular, in order to verify the improvement of the indoor air quality obtained, in the first thirty-day trial due to activation of such equipment;
2. conducted between August 2 and September 5, 2011;
3. performed in a waiting room with turnover of 1300 daily visitors and 4 visiting rooms located on the same ground floor of a building of the Hospital of Saronno - Piazzale Borella, 1 - 21047 SARONNO.

The bioreactors examined are able to:

1. attract, in particular, fine particles also thanks to the phenomenon of diffusion. In this regard, it recalls that the finest particles do not settle by gravity or respond to ventilation, technically not captured by the HEPA systems with relatively smaller than 0.3 microns [\[1\]](#)
2. separate, by the flow of treated air, the particulate present thanks to the washing with a current of water;
3. treat organic substances separated by using the principle of miniaturized bio-oxidation. Inside the CAPs, in fact, a specific formulation of biomass is added monthly, referred to as BioOx®, which adheres on the inner walls of the bioreactor called BioStack®. In this regard, please note that the oxidation of organic matter captured bacteria and facilitates the management of the final residual product from the bioreactors, which has been tested FREE from pathogenic bacteria, after operating for 90 days, with a specific search for Escherichia coli, Intestinal enterococci, pathogenic staphylococci, pseudomonas aeruginosa, salmonella, legionella, performed by ARPA.

The results of experiments carried out show after only one month of monitoring, that the bioreactors used in clinics have allowed, in general, to obtain:

1. a reduction in the number of bacterial colonies detectable with % values even higher than 95% compared to data from the beginning of the experiment (see the next chapter 4);
2. a reduction in the number of fine particles with % values up to 90% compared to the initial concentration (see the next chapter 4) and the attainment of the standard ISO-7 for the sieve fraction equal to 1 micron.

These results, presented later in the document, are to be considered extremely positive in light of the conditions under which the experiments were carried out (such as open windows, the continuous passage of personnel and / or patients, the presence of air conditioners, etc..).

Besides the presentation of numerical data reported with appropriate monitoring equipment, it is observed that the hospital staff involved in the testing, as evidence by the operators themselves have provided:

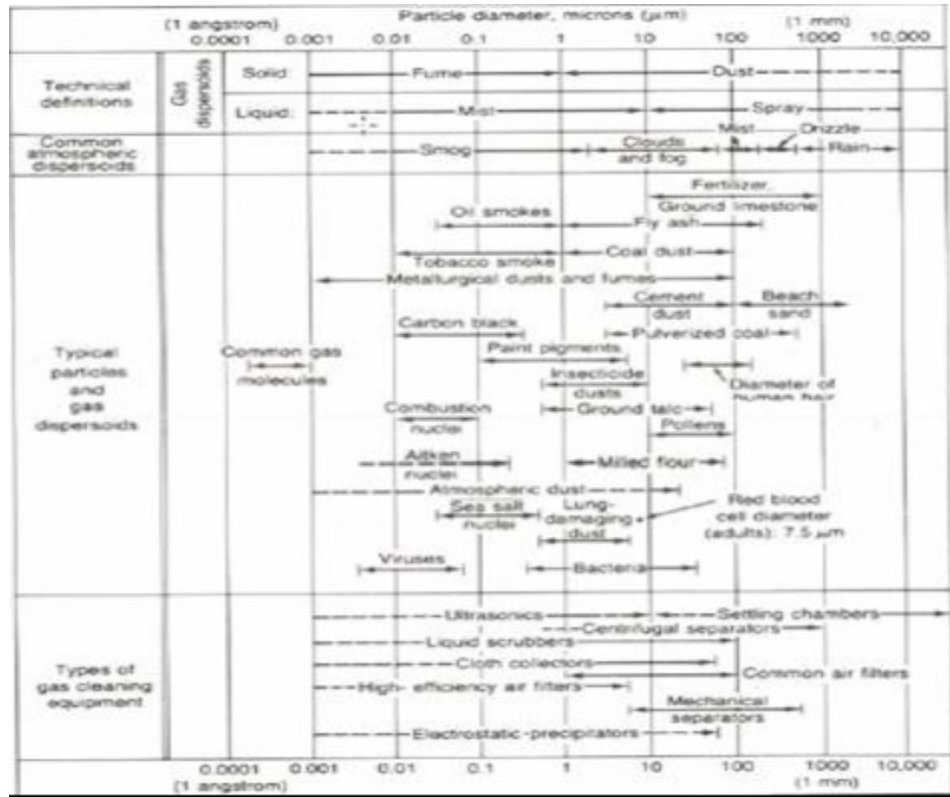
1. have perceived, in general, improved indoor air quality;
2. has indicated, in the case of allergic subjects, a lower sensitivity.

## 2. Air contamination in hospitals: introductory concepts

The following table provides information (in the form of *faq = Frequently Asked Questions*) related to the phenomena of air contamination of the indoor air in hospitals. The concepts are useful to better understand the mode of operation of the equipment under test.

<b>Table 2.1 - The contamination of the air in hospitals: introductory concepts</b>		
<b>No.</b>	<b>Questions</b>	<b>answers</b>
<u>1</u>	What are the main contaminants that are found in hospitals	<p>Regarding the presence of contaminants in hospital environments, these can be classified into three broad categories:</p> <ol style="list-style-type: none"> <li>1. pollutants physical in nature (eg, ionizing and non-ionizing radiation, artificial mineral fibers, powders, etc..)</li> <li>2. pollutants of chemical nature, including pollutants of inorganic nature (carbon monoxide and carbon dioxide, oxides of sulfur and nitrogen, ozone, etc..) and organic (volatile organic compounds, etc..)</li> <li>3. and finally (Table 2) the pollutants of microbiological nature (bacteria, fungi, mold, pollen, etc..).</li> </ol>
<u>2</u>	What kind of pollutants can lead to problems with particular reference to medical and paramedical staff?	<p>Among the pollutants mentioned above, the VOC (Volatile Organic Compounds) such as anesthetic gases or fumes may be caused by disinfectants, particularly for medical and paramedical staff, a problem because the receptors, in this case, are exposed for long periods to this type of contamination.</p>
<u>3</u>	What kind of pollutants can cause problems with regard to patients and / or visitors?	<p>The bacteria in the air can create many types of respiratory infections, skin, hair and more. Bacterial infections in recent years have become of major concern due to the resistance of organisms to anti microbial agents, making treatment difficult if not impossible.</p> <p>The bacteria in indoor environments are the cause of many human infections contracted in hospitals like structures, each year in the U.S. are approximately 2 million infections contracted in hospitals are estimated 20,000 deaths each year attributable to hospital-acquired pneumonia.</p>
<u>4</u>	In general, what characteristics the main pollutants mentioned before share?	<p>Both the gas molecules (including those with low olfactory threshold that determine odor) and some types of viruses and bacteria are very small in size as they are less than 0.2 m, and therefore are subject to Brownian motion and move by diffusion .</p>
<u>5</u>	how do they spread?	<p>From the physical point of view, the main phenomenon that regulates the displacement of gas and submicronic particulate pollutants is regulated by the phenomenon of diffusion based on Fick's law. For the basis of this phenomenon, the pollutants move following the concentration gradient.</p>

6	<u>Particle size contaminants</u>
---	-----------------------------------



7	<u>What other features relate to indoor particulates?</u>
---	---

The air particles vary in size, concentration and time of settlement on the ground. More than 98% of the particulates in a room are very small, less than 2 microns from the air and essentially dont settle by gravity. The air currents in a room retain and move large particulates, channeling it in the pipes and subsequently to the filters.

Most of the small particulates are not retained or moved by air currents because the area of their section is too small. The movement of the finest particles is determined mainly by the local electric fields that exist in all rooms.

The fine particulate matter tends to move along the lines of the electric field and to be deposited on people or objects. So relatively few particles arrive in the pipes, and consequently very few reach the filters commonly used in hospitals.

### 3.The characteristics of the bioreactors object of experimentation

#### 3.1. Introduction

The following table provides information (in the form of *faq = Frequently Asked Questions*) related to the functionality and features of bioreactors object of experimentation.

#### 3.2. Mode of operation of bioreactors object of testing: introductory concepts

The following table provides information (in the form of *faq = Frequently asked questions*) regarding the methods of operation of bioreactors object of testing. Understanding the mode of operation is also facilitated by the subsequent Fig. 3.1.

**Table 3.1 - Mode of operation of bioreactors object of testing: introductory concepts**

No.	Questions	answers
1	<p><u>Why is the proposed technology effective against the pollutants described above?</u></p>	<p>The proposed technology is effective, in particular, for two reasons:</p> <ol style="list-style-type: none"> <li>1. it creates a displacement of the particles toward the purification system by exploiting the phenomenon of diffusion and electrical natural charge attraction, and therefore limiting need of extra forced ventilation and the related consumption of energy;</li> <li>2. completing, within the filter, the air purification process, since the electrically charged particles are separated also thanks to the washing with a water flow, and organic compounds are oxidized due to the biomass which develops in the filter itself.</li> </ol>
2	<p><u>How does the equipment draw submicron pollutants and limits the indoor ventilation required?</u></p>	<p>The equipment in question takes advantage of the phenomenon of diffusion combined with natural electrical charge attraction, which creates a "Grounded air zone". In fact, as the device is installed and activated, the flow of incoming air is determined by the operation of the fan placed at the head of the filter cartridge for the larger particles, combined with the "grounded neutral zone" created naturally by the bioreactor which attracts by electrical charge potential difference the smaller particles with no size limitations.</p> <p>In fact, in the biofilter there is the separation of fine particles and air, and the air, purified, is recirculated. In doing so, the system creates a clean air zone and pollutants move toward the very clean area (located in proximity of the equipment) due to the concentration gradient. Just a small cloud area, just on top of the fan, could be occasionally carrying pollution concentrations while collapsing into the system. As the clean area is expanded, the radius of influence of the system increases.</p>
3	<p><u>In which way is the system able to separate submicronic particles?</u></p>	<p>The system is able to intercept submicronic particles as these are loaded from the point of view of an electrostatic and go to interact not only with the biofilter, but also with a film of water which is electrically neutral (as the tank itself recirculation of 'Water is grounded). Upon contact with the water layer, the electrically charged particle loses its charge and is intercepted.</p>
4	<p><u>Where has the system been already used successfully for long term installations ?</u></p>	<p>As is clear from scientific publications ( <u>Sam Sofer, Ph.D., PE THE CLEAN AIR RESOURCE Guide: BIO-OXIDATION CONTROLS LAB Odors - Pollution Engineering Magazine, June 2006</u> ), D from 2003, the system is used at New Jersey Medical School, University Heights, in Newark is (University of Medicine and Dentistry of New Jersey)</p>
5	<p><u>Which are the areas of the hospital mentioned above, in which the systems were introduced in the facility and what problems did they solve?</u></p>	<p>In particular (see publication above mentioned ) Improvements have occurred:</p> <ol style="list-style-type: none"> <li>1. in the orthopedic department, the top floor of the building was subject to leakage of fumes from the nearby landing pad of the helicopter on the roof;</li> <li>2. the transport area near the loading dock of the ground floor had problems with the exhaust of trucks and ambulances coming and going;</li> <li>3. the laboratory of cell biology and the laboratory hosting guinea pig tests. The small rooms permeated with the smell of the animals ;</li> <li>4. the anatomy laboratory had a double problem from the start: relatively crowded environment from students and strong odors from the chemicals used for the storage of samples and bodies</li> <li>5. four operating rooms in the dental clinic needed a reliable way to</li> </ol>

extract the nitrous oxide from the room to teach the use of gas as an anesthetic in dental surgery.

Most of the problems involved simply odor control. The exceptions were the four operating rooms, where the mandatory limitation of nitrous oxide was an OSHA requirement.

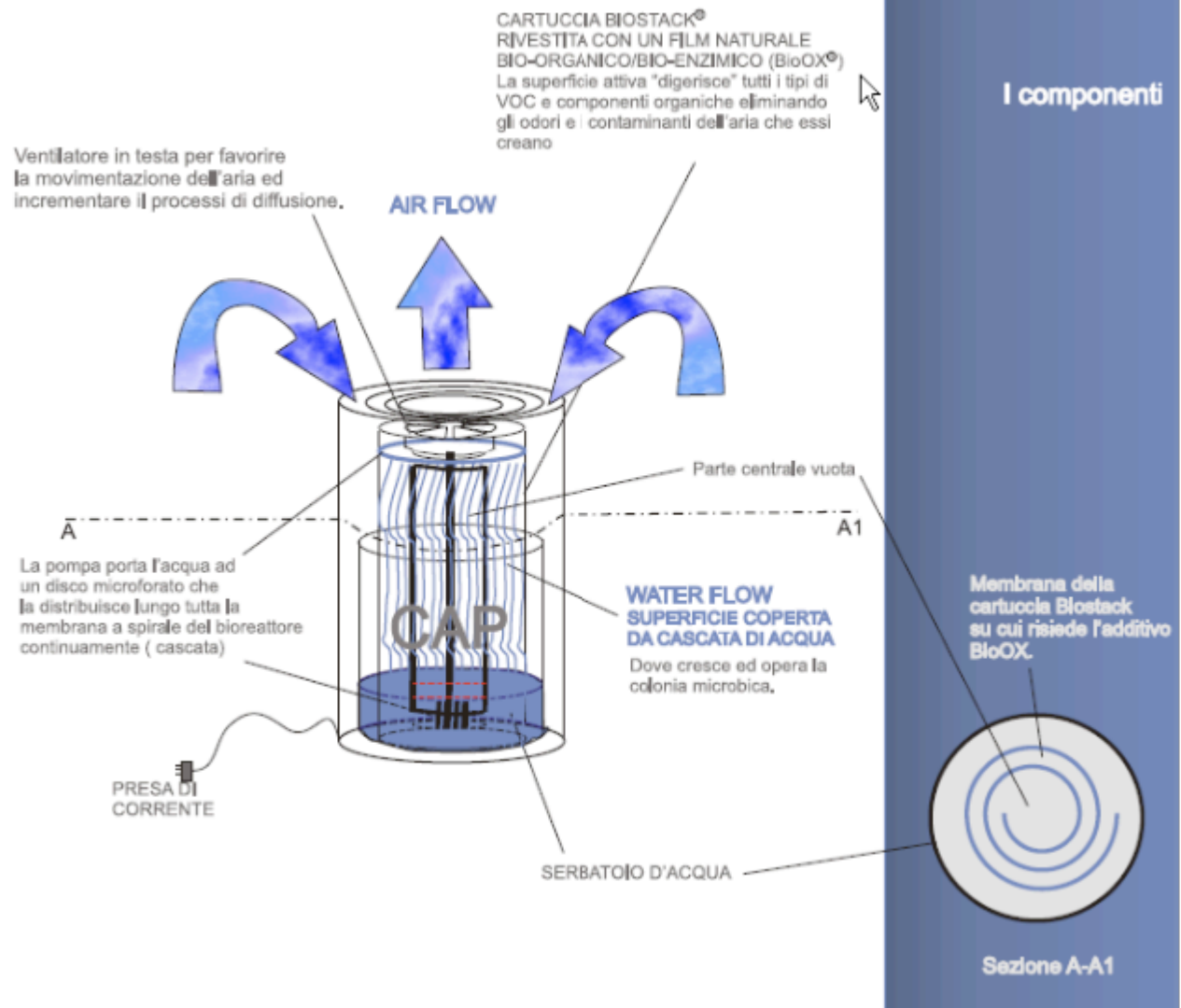


Figure 3.1 - Mode of operation of the Cap

### 3.3. The winning features of bioreactors object of testing

Below are summarized some of the winning features of the technology object of testing

**The CLEAN AIR PLANTS (CAP™) devices are small and portable.**

The CAP™ (Clean Air Plants) bio-oxidation units are stand-alone performing a mixing of the air of the areas where they are installed. The CAP™ capture and destroy odors and other indoor contaminants, thus ensuring the safety and health of the people, by preventing that the contaminants are dispersed or more simply transported from one place to another.

The Clean Air Plants are a new type of bio-oxidation units, using bio-films combined with immobilized enzymes for the destruction of vapors, gases, organic compounds and hazardous materials in indoor air.

With the application of bio-hygienic technology operated by CAP™, these small and portable devices can be installed anywhere in areas with high pollution and VOC fumes which create odors and poor air quality.

The filter coil generates a range of influence which expands as it works, creating a "zone of clean air". The contaminants, as well as the odors generated by them, are attracted to this zone of clean air (generally pollution moves from the high to the low concentrations) where the particles are removed and the organic compounds oxidised.

Bio-oxidation is a sustainable technology that does not require high temperatures or pressures or excessive energy to function. The filter cartridges are spiral in a new patented variety of bio-oxidation technology. They have the advantage of being portable biological systems, and to be the only systems that address the dynamics of indoor air with the creation of a clean air zone.

**The purification technology used by CLEAN AIR PLANTS (CAP™) allows you to achieve levels of air quality which cannot be reached with CONVENTIONAL TECHNOLOGIES alone.**

Airborne contaminants are first captured and subsequently digested biologically. The winning factor of bio-hygenics is that simple ventilation cannot be used for the capture of particulates or viruses; contaminants, and persistent odors, are travelling on the particulates, which are electrically charged, and their movement is controlled by electrical fields and not from air streams.

The conventional air treatment systems are generally related to ventilation, operating through expulsion of the ambient air with relative intake of air previously filtered. In general, what is commonly used is a simple air conditioning system ( HVAC)

This ventilation is expensive and not completely safe, because:

- . does not work with high loads of pollution,
- . fails to move the largest percentage of the particulates as a non-reactive to the ventilation but only to the electric charges,
- . can not handle sudden loads, and
- . does not remove the particulates in the air, which often move from one location to another.

**The operation of the CLEAN AIR PLANTS (CAP™) means low power consumption and low operating costs**

The clean air zone formed by the CAP™ is generated with an extremely low power consumption.

The increased destruction of the contaminants produced by the CAP means a significant reduction of requests for ventilation.

The associated savings are:

- . require less air conditioning and heating, so less wear on the equipment and its maintenance
- . cost reduction of architectural and construction associated with a reduction of the air treating plant size and related ducting



. safer for the environment treated. All the contaminants, of any type and size, are captured and destroyed.

---

[1] See, for example, the following publication: Dr. Linda J. Utrup PhD, Kenneth Werner and Allan H. Frey PhD - Minimizing Pathogenic Bacteria, Including spores in indoor air

## **4. TEST: areas, type of CAP units used and monitoring techniques**

### **4.1. Introduction**

The following paragraphs contain information on:

4. areas where the testing was carried out;
5. type of CAP units used;
6. the monitoring techniques applied to verify the results.

### **4.2. General Info**

the testing was carried out by

4. Testing performed by U-earth for the Hospital of Busto Arsizio, Saronno and Tradate
5. in collaboration with the General Director, Dr. Gozzini, with the Director of the health department, Dr. Roberto Cosentina, and by Saronno's hospital laboratory of analysis.
6. with the participation of ASL Brescia, ASL Varese, ARPA Lombardia, Mr. Alfonso Andretta, professor at the Faculty of Engineering, University of Modena.

The tools for the detection and training for monitoring officers were provided by AL & CO, ORION, International PBI.

### **4.3 The area of testing**

The testing was held in a waiting room, it is held and in a block of poly-ambulatory composed of four rooms used as visiting rooms visible in Fig. 4.1.

Each room has the following dimensions:

Width: 3.40 m Length: 5.20 m Height: 3.00 m

Area: 18.00 m<sup>2</sup> Volume: 54.00 m<sup>3</sup>

The waiting room has approximately the following dimensions:

Width: 5.40 m Length: 14.00 m

Each visiting room communicates with the waiting room through a door of the size 80 cm x 210 cm and outwardly through a windowed wall.

The waiting room next to the four visiting rooms is connected to another confined space, much larger, with no dividing door.

There is an HVAC system for air conditioning of premises, connected to the system which serves the entire hospital.

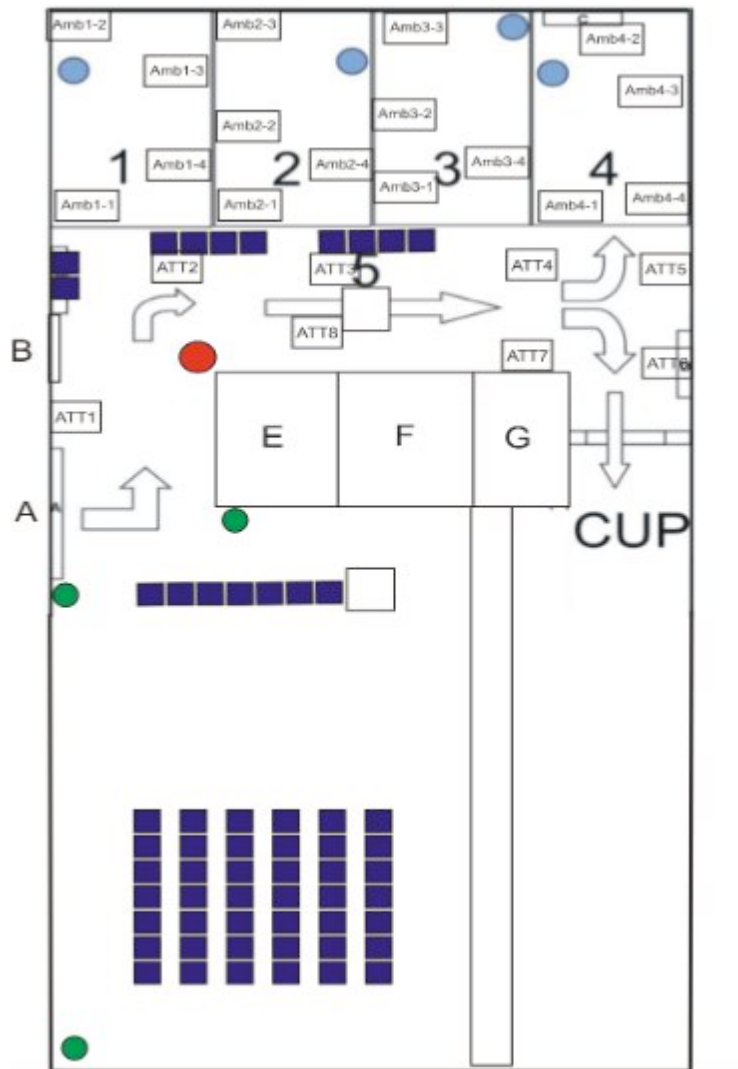


Figure 4.1 - Plan of the testing zone [1] : the visiting rooms are numbered from 1 to 4. N. 4 CAP-85 (1 in each room) are indicated by blue points, the CAP-600 (waiting room) is indicated by the red dot. The measuring points, used for particle counting, are indicated by abbreviations in small boxes.

### 4.3 The cap installed

As shown in Fig. 4.1, in the area object of testing, the following equipment has been installed:

**N. 4 CAP-85 (# 1 in every visiting room)**

**N. 1 CAP-600 (waiting room)**

The main dimensional characteristics of the CAPs are the following.

#### **CAP-85**

Power supply 230 volts AC, 50 Hertz  
Consumption 24 Watt  
Dimensions 82 cm x 38 cm  
Weight 27 Kg  
equivalent venting capacity 1,700 m<sup>3</sup>/hr  
Contaminant destruction capacity 4.5 kg / day

#### **CAP-600**

Power supply 230 volts AC, 50 Hertz  
Consumption 420 Watts  
Dimensions 170 cm x 76 cm  
Weight 48 Kg  
equivalent venting capacity 8,500 m<sup>3</sup> / hour  
Contaminant destruction capacity 27 kg / day

**It is also noted, that the bioreactors were never turned off in the course of the trial operating 24/7**

### ***4.4. Monitoring techniques applied: detection tools***

For the detection of particle contamination of the air the following equipment was used:  
Aero Trak™ Portable Airborne Particle Counter Model 9350.



*Figure 4.3 - Aero Trak™ Model 9350 Portable Airborne Particle Counter used for particle counting*

For the detection of microbiological contamination of the air has been used an air sampler (SAS Surface Air System) Super IAQ model 90593.



Figure 4.4 - Air Sampler SAS (Surface Air System) Super IAQ model 90593 used for the detection of microbiological contamination of the air

## 5. Presentation of results: summary

### 5.1. Introduzione

The following chapter will include information on the results obtained in the course of the trial took place from 02/08/2011 to 05/09/2011 in the above outlined area on the ground floor of the hospital of Saronno. From now onwards the rooms are indicated by the numbering shown in the map (see Fig. 4.1

The results relate to:

3. the measurement of bacteria, in some points of the rooms, performed using *SAS Air Sampler* (see chap.4)
4. the measurement of particle size range of particulates in the range between 0.3 to 5 microns (see chap.4)

### 5.2.Reduction of bacterial colonies

#### 5.2.1.Introduction

For the detection of microbiological contamination of the air has been used an air sampler (*SAS Surface Air System*) Super IAQ model 90593.The measurements refer to the days 02/08/2011, 04/08/2011, 06/08/2011, 08/08/2011, 10/08/2011, 12/08/2011, 14/08 / 2011, 16/08/2011 and 20/08/2011.

#### 5.2.2.Reduction of bacterial colonies: summary of results obtained in room 1

The results of monitoring conducted in room 1 were synthesized:

1. in a table showing the number of bacterial colonies detected from the laboratory of the Hospital of Saronno, on swabs obtained during sampling. The same table also shows the variation in the number of bacterial colonies observed compared to the original measure. This change, expressed both in absolute and in percentage, provides a clear indicator of killing obtained following the entry into operation of the CAP;
2. in a graph (see Fig.5.1) in which are reported:
  - 2.1. the measurements results, which indicate the steady reduction of bacterial colonies detected;

2.2. The linear trend of the measurements. This straight line, obtained by interpolating the monitoring data, provides the trend curve of the measures.

Tab.5.1 — bacterial colonies present in samples taken in room 1				
No.	Date	N. of bacterial colonies detected	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	85		
2	04/08/2011	32	-53	-62%
3	06/08/2011	14	-71	84
4	08/08/2011	29	56).	-66%
5	10/08/2011	6	-79	[93]
6	12/08/2011	7	-78	-92%
7	14/08/2011	2	-83	-98%
8	16/08/2011	5	80%	-94%
Providers	20/08/2011	Providers	-76	-89%

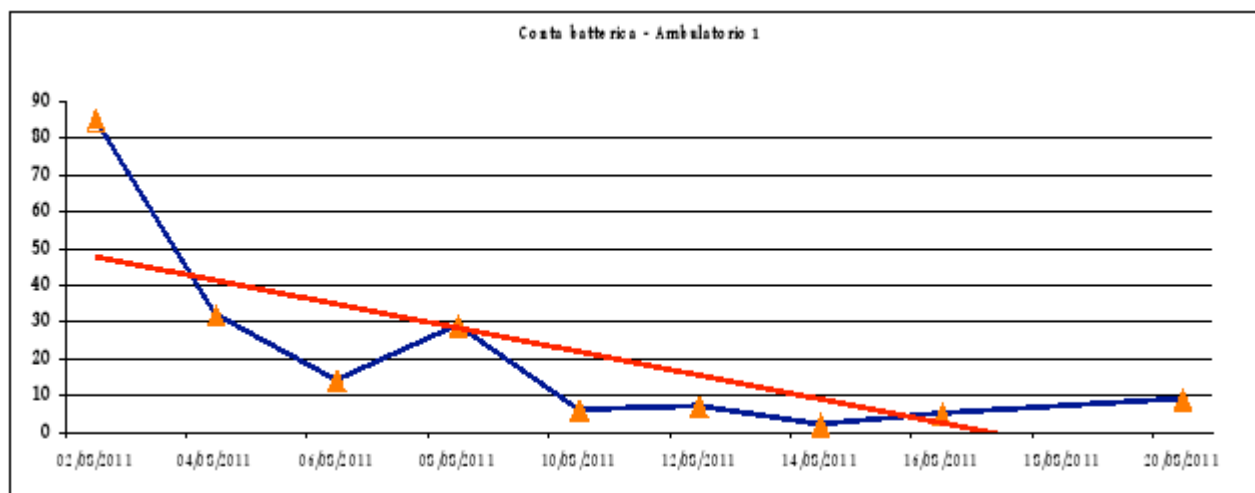


Fig 5.1 - Results of the monitoring of bacterial of room 1, the red trend line

In relation to the monitoring of bacterial contamination performed at the room no. 1, from the examination of Table 5.1 and the graph of fig.5.1, you can conclude that, after only one month of monitoring, the bioreactors used in the visiting rooms have resulted in a progressive reduction in the number of bacterial colonies with detectable rates of reduction, calculated on the figure recorded at the beginning of the trial, with values %, even higher than 95%. In particular, it has changed from a value equal to 85 CFU / m<sup>3</sup> (measured at 02.08.2011) to values (detected since 08/10/2011) of less than 10 CFU / m<sup>3</sup>.

### 5.2.3.Reduction of bacterial colonies: summary of results obtained room 2

The results of monitoring conducted in room 2 were synthesized: 1. in a table showing the number of bacterial colonies detected from the laboratory of the Hospital of Saronno, on swabs obtained during sampling. The same table also shows the variation in the number of bacterial colonies observed compared to the original measure. This change, expressed both in absolute and in percentage, provides a clear indicator of killing obtained following the entry into operation of the CAP; 2. in a graph (see Fig.5.2) in which are reported: 2.1.

the measurements results, which indicate the steady reduction of bacterial colonies detected; 2.2. The linear trend of the measurements. This straight line, obtained by interpolating the monitoring data, provides the trend curve of the measures.

Tab.5.2 – bacterial colonies present in samples taken in room 2				
No.	Date	room 2	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	34		
2	04/08/2011	12	-73	-86%
3	06/08/2011	/24.	-61	-72%
4	08/08/2011	15	70	-82%
5	10/08/2011	6	-79	[93]
6	12/08/2011	4	-81	-95%
7	14/08/2011	8	-77	-91%
8	16/08/2011	5	80%	-94%
Providers	20/08/2011	6	-79	[93]

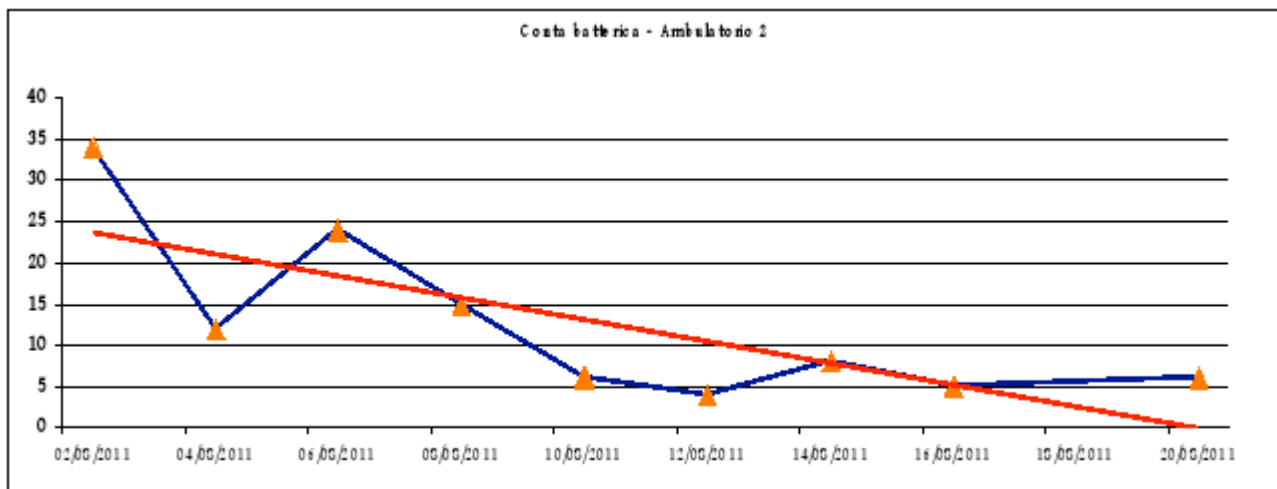


Fig 5.2 - Results of the monitoring of bacterial of room 2, the red trend line

In relation to the monitoring of bacterial contamination performed at the laboratory no. 2, an examination of Table 5.2 and the graph of Fig.5.2, **you can deduce that**, after only one month of monitoring, the bioreactors used in surgeries **have resulted in a progressive reduction in the number of bacterial colonies with detectable rates of reduction, calculated on the figure recorded at the commencement of the trial, with values % maximum at 95%**. In particular, it has changed from a value equal to 34 CFU / m<sup>3</sup> (measured at 02.08.2011) to values (detected since 10.08.2011) below 9 CFU / m<sup>3</sup>.

### 5.2.4.Reduction of bacterial colonies: summary of results obtained in room 3

The results of monitoring conducted in room 3 were synthesized: 1. in a table showing the number of bacterial colonies detected from the laboratory of the Hospital of Saronno, on swabs obtained during sampling. The

same table also shows the variation in the number of bacterial colonies observed compared to the original measure. This change, expressed both in absolute and in percentage, provides a clear indicator of killing obtained following the entry into operation of the CAP; 2. in a graph (see Fig.5.3) in which are reported: 2.1. the measurements results, which indicate the steady reduction of bacterial colonies detected; 2.2. The linear trend of the measurements. This straight line, obtained by interpolating the monitoring data, provides the trend curve of the measures.

Tab.5.3 — bacterial colonies present in samples taken in room 3				
No.	Date	room 3	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	51		
2	04/08/2011	23	-62	-73%
3	06/08/2011	15	70	-82%
4	08/08/2011	18	-67	-79%
5	10/08/2011	12	-73	-86%
6	12/08/2011	7	-78	-92%
7	14/08/2011	3	-82	-96%
8	16/08/2011	5	80%	-94%
Providers	20/08/2011	2	-83	-98%

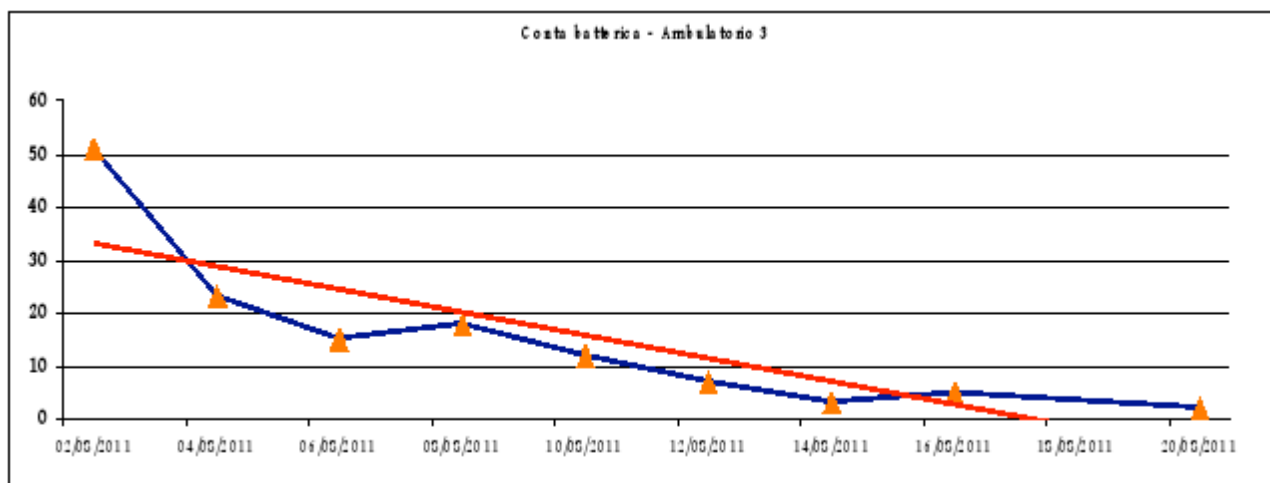


Fig 5.3 - Results of the monitoring of bacterial contamination in room 3, the red trend line

**In relation to the monitoring of bacterial contamination performed at the laboratory no. 3, from the examination of Table 5.3 and of graph in Fig.5.3, you can conclude that, after less than a month of monitoring, bioreactors used in the visiting rooms have resulted in a progressive reduction in the number of bacterial colonies with detectable rates of reduction, calculated on the figure recorded at the beginning of the trial, with % maximum values of 98%. In particular, it has gone from a value of 51 CFU / m<sup>3</sup> (measured at 02.08.2011) to values equal to 2 CFU / m<sup>3</sup> (found on 08/20/2011).**

### 5.2.5.Reduction of bacterial colonies: summary of results obtained in room 4

The results of monitoring conducted in room 4 were synthesized: 1. in a table showing the number of bacterial colonies detected from the laboratory of the Hospital of Saronno, on swabs obtained during sampling. The same table also shows the variation in the number of bacterial colonies observed compared to the original measure. This change, expressed both in absolute and in percentage, provides a clear indicator of killing obtained following the entry into operation of the CAP; 2. in a graph (see Fig.5.4) in which are reported: 2.1. the measurements results, which indicate the steady reduction of bacterial colonies detected; 2.2. The linear trend of the measurements. This straight line, obtained by interpolating the monitoring data, provides the trend curve of the measures.

Tab.5.4 – bacterial colonies present in samples taken in room 4				
No.	Date	room 4	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	50		
2	04/08/2011	15	70	-82%
3	06/08/2011	20	-65	-76%
4	08/08/2011	31	54	-64%
5	10/08/2011	8	-77	-91%
6	12/08/2011	7	-78	-92%
7	14/08/2011	4	-81	-95%
8	16/08/2011	3	-82	-96%
Providers	20/08/2011	2	-83	-98%

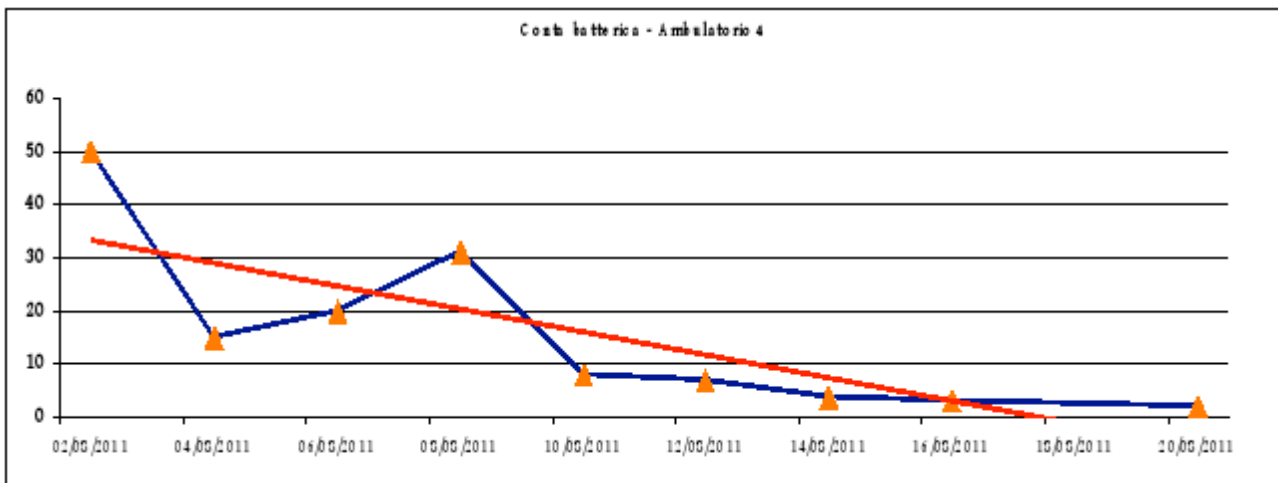


Fig 5.4 - Results of the monitoring of bacterial in room 4, the red trend line

**In relation to the monitoring of bacterial contamination performed at room no. 4, from an examination of Table 5.4 and the graph of Fig.5.4, you can conclude that, after less than a month of monitoring, the bioreactors used in the visiting rooms have resulted in a progressive reduction in the number of bacterial colonies with detectable rates of reduction, calculated on the figure recorded at the beginning of the trial, with % maximum values of 98%.In particular, it has changed from a value of 50 CFU / m<sup>3</sup> (measured at 02.08.2011) to values equal to 2 CFU / m<sup>3</sup> (detected on 20.08.2011).**



## **5.3 Reduction of airborne particles (particulate matter)**

### **5.3.1. Introduzione**

For the detection of particulate air Contamination the following equipment was used: Aero Trak™ Portable Airborne Particle Counter Model 9350. The measurements details are:

1. taken on days 02/08/2011, 04/08/2011, 06/08/2011, 08/08/2011, 10/08/2011, 12/08/2011, 14/08/2011, 16/08/2011, 20/08/2011, 02/09/2011 and 05/09/2011;
2. for the following size classes 0.3 microns, 0.5 uM, 1 uM, 2 uM, 3 uM and 5 pm;
3. were carried out in conditions of full operation: with windows open, passage of personnel and / or patients, the presence of air conditioners and other equipment (such as computers and printers) in function. In this regard, please note that for the control of air quality in surgery rooms, ISO reference refers, for the assessment of the concentration of particles, to conditions of the operating room ready (at rest = ready for use operating room and in the absence of staff ). The conditions under which the monitoring activities were carried out are, therefore, to be considered extremely disadvantageous.

### **5.3.2.Reduction of airborne particles: summary of results obtained room 1**

The results of monitoring conducted in room 1 were synthesized:

1. for particles with a diameter of 0.5 uM:
  - 1.1. on a table showing for each of the dates of monitoring:
    - 1.1.1. the average of the measurements made in each of the 4 sampling points;
    - 1.1.2. the average for all measurements the room;
    - 1.1.3. the 95-th percentile on all measurements in the room. This figure, in accordance with the provisions of standard ISO 14644-1, is the value to be used to define the level of particulate contamination that characterizes environments subject of measures;
    - 1.1.4. the variation, calculated with respect to the initial starting value, of the data reported in the preceding paragraph. This change, expressed both in absolute and in percentage, provides a clear indicator of abatement obtained following the entry into operation of the CAP;
  - 1.2. in a graph (see Fig.5.5) in which are reported:
    - 1.2.1. the measurements, which indicate the steady reduction of bacterial colonies detected through particulate matter capture;
    - 1.2.2. The linear trend of the measurements. This line, obtained by interpolation of monitoring data, provides the performance of statistical measures;
2. the same also for the processing of the particles with a diameter of 1 micron. In particular:
  - 2.1. in Table 5.6, are highlighted in yellow the values that allow the achievement of ISO-7;
  - 2.2. the graph (see Fig.5.6) also contains the straight line that indicates the standard ISO-7. This representation allows to visually verify the attainment of the standard referred to above.

Tab.5.5-Summary statistics for room 1 (particle diameter of 0.5 µm)									
No.	Date	average 1-1	Average of 1-2	average 1-3	average 1-4	Average room 1	95 th percentile	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	6,771,073	7,325,040	7,064,833	8,311,500	7,368,112	8,163,531		
2	04/08/2011	3,397,060	3,916,060	3,803,067	3,740,500	3,714,172	3,899,111	4,264,420	52.24%
3	06/08/2011	1,302,387	1,371,033	1,341,300	1,365,653	1,345,093	1,370,226	6,793,305	83.22%
4	08/08/2011	6,275,473	6,342,453	5,924,493	5,954,887	6,124,327	6,332,406	1,831,125	22.43%
5	10/08/2011	545,120	553,340	575,480	606,560	570,125	601,898	7,561,633	92.63%
6	12/08/2011	1,693,620	1,749,453	1,761,633	1,771,860	1,744,142	1,770,326	6,393,205	78.31%
7	14/08/2011	2,781,067	2,786,733	2,729,840	2,735,623	2,758,316	2,785,883	5,377,648	65.87%
8	16/08/2011	1,150,750	1,134,137	1,093,533	1,085,937	1,116,089	1,148,258	7,015,273	85.93%
Providers	18/08/2011	910,540	966,080	945,967	980,833	950,855	978,620	7,184,911	88.01%
10	20/08/2011	601,687	623,227	622,920	630,820	619,663	629,681	7,533,850	92.29%
11	02/09/2011	852,680	912,913	876,127	937,920	894,910	934,169	7,229,362	88.56%
12	05/09/2011	416,013	557,313	565,873	712,973	563,043	690,908	7,472,623	91.54%

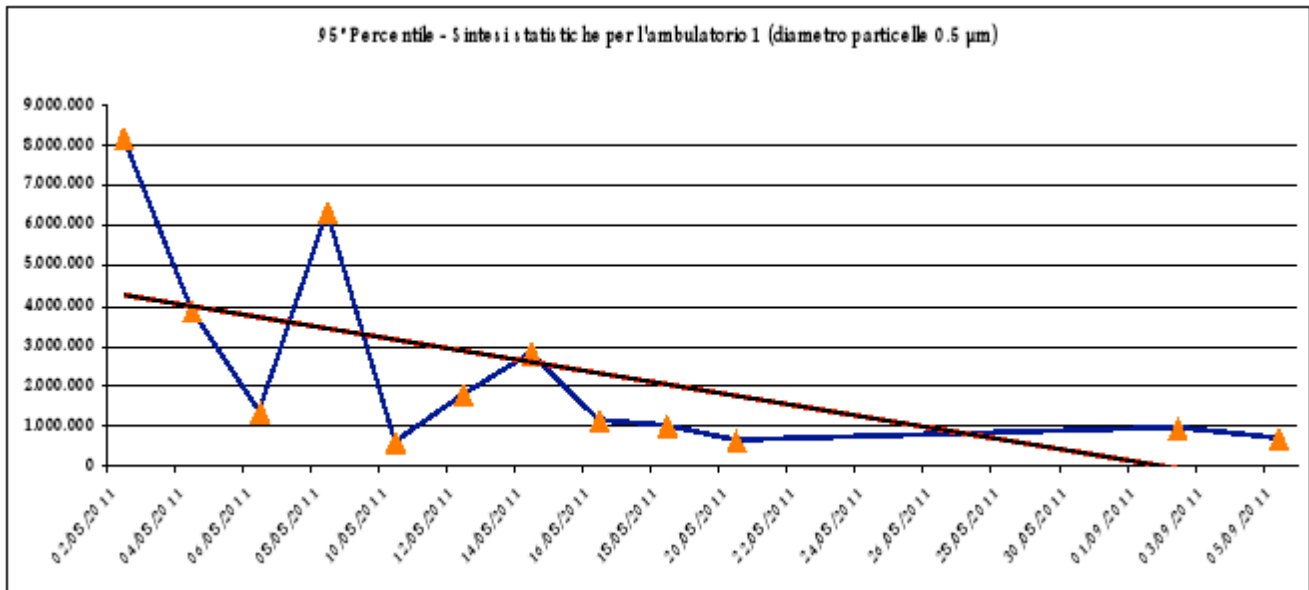


Fig 5.5 - Results of particle counting in room 1 for particles with a diameter of 0.5 µm, with the red trend line

Tab.5.6 - Summary statistics for room 1 (1 micron particle diameter)									
No.	Date	average 1-1	Average of 1-2	average 1-3	average 1-4	Average room 1	95 th percentile	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	516,767	527,827	485,167	558,033	521,948	553,502		
2	04/08/2011	428,513	498,933	487,960	486,347	475,438	497,287	56,215	10.16%
3	06/08/2011	129,220	146,227	160,467	173,907	152,455	171,891	381,612	68.94%
4	08/08/2011	515,487	538,613	549,633	584,413	547,037	579,196	-25,694	-4.64%
5	10/08/2011	95,273	100,280	107,267	111,273	103,523	110,672	442,830	80.01%
6	12/08/2011	207,693	233,527	241,213	247,627	232,515	246,665	306,838	55.44%
7	14/08/2011	352,527	351,527	365,933	369,303	359,823	368,798	184,705	33.37%
8	16/08/2011	177,063	174,890	158,743	175,220	171,479	176,787	376,716	68.06%

8	18/08/2011	36,100	40,293	50,087	58,687	46,292	57,397	496,106	89.63%
10	20/08/2011	39,533	52,007	50,593	57,467	49,900	56,648	496,855	89.77%
11	02/09/2011	50,007	64,333	66,253	82,107	65,675	79,729	473,774	85.60%
12	05/09/2011	55,720	114,960	132,853	146,940	112,618	144,827	408,675	73.83%

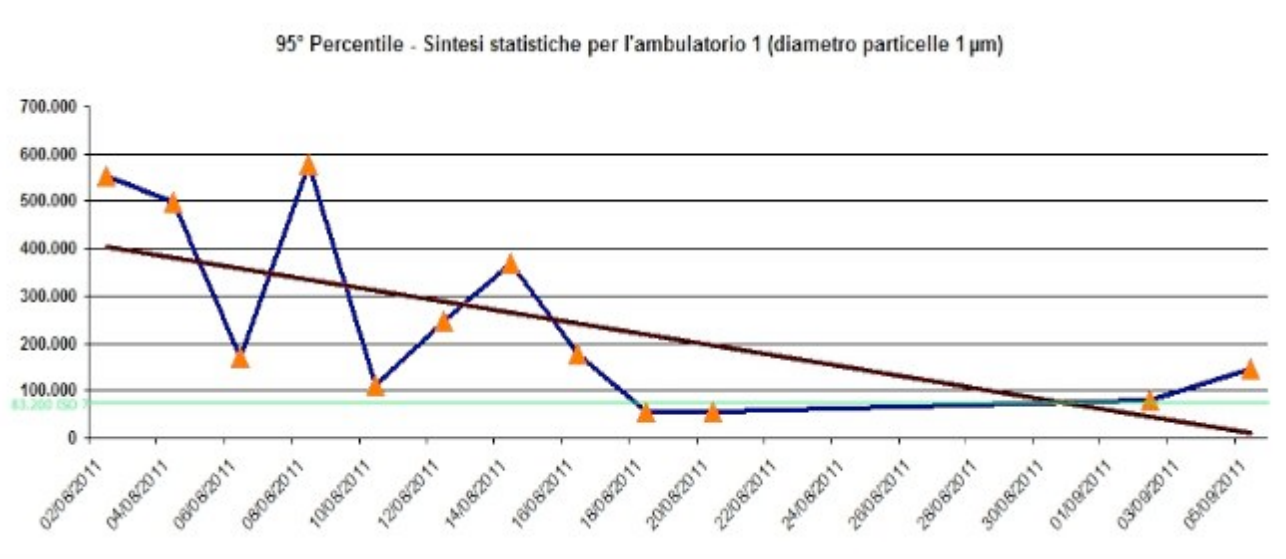


Fig 5.6 - Results of particle counting in room 1 for particles with a diameter of 1 micron, in red tendency of the straight line, in blue the straight line that indicates the standard ISO-7

In relation to the monitoring of particulate contamination performed in room no. 1, an examination of Tables 5.5 and 5.6 and the graphs in Fig.5.5 and 5.6, it is possible to conclude that, after a month of monitoring, the bioreactors used in visiting rooms have resulted in a progressive reduction in the presence of fine particles. In particular:

1. for what concerns the sieve fraction of 0.5 µm, the monitoring data show a reduction percentage, calculated with respect to the data detected at the beginning of the experiment, which reached values greater than 90%;
2. for what concerns the sieve fraction equal to 1 micron, the monitoring data show:
  - 2.1. a reduction percentage, calculated with respect to the data detected at the beginning of the experiment, which reached values close to 90%;
  - 2.2. and the achievement, in three successive measurements, of the standard ISO-7.

### 5.3.3.Reduction of airborne particles: summary of results obtained room 2

The results of monitoring conducted in room 2 were synthesized:

1. for particles with a diameter of 0.5 µm:
  - 1.1. on a table showing for each of the dates of monitoring:
    - 1.1.1. the average of the measurements made in each of the 4 sampling points;
    - 1.1.2. the average for all measurements the room;
    - 1.1.3. the 95-th percentile on all measurements in the room.This figure, in accordance with the provisions of standard ISO 14644-1, is the value to be used to define the level of particulate contamination that characterizes environments subject of measures;

1.1.4. the variation, calculated with respect to the initial starting value, of the data reported in the preceding paragraph. This change, expressed both in absolute and in percentage, provides a clear indicator of abatement obtained following the entry into operation of the CAP;

1.2. in a graph (see Fig.5.7) in which are reported:

1.2.1. the measurements, which indicate the steady reduction of bacterial colonies detected through particulate matter capture;

1.2.2. The linear trend of the measurements. This line, obtained by interpolation of monitoring data, provides the performance of statistical measures;

2. the same also for the processing of the particles with a diameter of 1 micron. In particular:

2.1. in Table 5.9, are highlighted in yellow the values that allow the achievement of ISO-7;

2.2. the graph (see Fig.5.8) also contains the straight line that indicates the standard ISO-7. And representation that allows you to visually verify the achievement of the standards mentioned above.

**Tab.5.7 - Summary statistics for room 2 (particle diameter of 0.5 µm)**

No.	Date	average 2-1	average 2-2	average 2-3	average 2-4	Average room 2	95 th percentile	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	12,109,853	13,434,987	12,697,680	12,320,753	12,640,818	13,324,391		
2	04/08/2011	2,864,500	3,147,240	3,150,893	3,579,747	3,185,595	3,515,419	9,808,972	73.62%
3	06/08/2011	1,661,847	1,577,627	1,684,327	1,550,300	1,618,525	1,680,955	11,643,436	87.38%
4	08/08/2011	10,154,673	10,564,547	10,312,227	10,171,607	10,300,763	10,526,699	2,797,692	21.00%
5	10/08/2011	1,183,000	1,283,587	1,248,140	1,217,900	1,233,157	1,278,270	12,046,121	90.41%
6	12/08/2011	1,874,760	1,888,160	1,881,013	1,958,393	1,900,582	1,947,858	11,376,532	85.38%
7	14/08/2011	3,160,173	3,188,647	3,190,053	3,062,787	3,150,415	3,189,842	10,134,548	76.06%
8	16/08/2011	1,855,017	3,645,473	3,608,647	3,625,600	3,183,684	3,642,492	9,681,898	72.66%
Providers	18/08/2011	1,132,467	1,157,220	1,053,273	1,126,780	1,117,435	1,153,507	12,170,884	91.34%
10	20/08/2011	731,247	740,440	701,020	718,780	722,872	739,061	12,585,330	94.45%
11	02/09/2011	1,864,040	2,126,533	1,807,053	1,666,140	1,865,942	2,087,159	11,237,231	84.34%
12	05/09/2011	1,096,187	1,068,440	1,113,020	1,069,427	1,086,768	1,110,495	12,213,896	91.67%

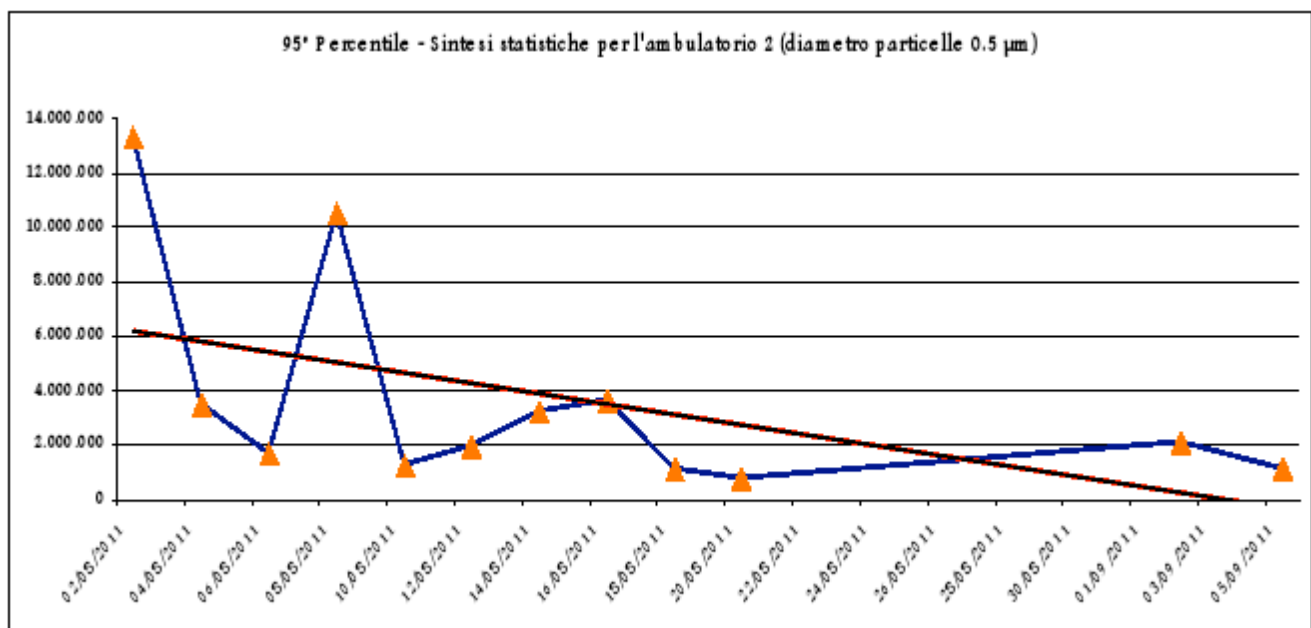


Fig 5.7 - Results of particle counting in room2 for particles with a diameter of 0.5  $\mu$ M, the trend line in red

Tab.5.8 - Summary statistics for room 2 (1 micron particle diameter)									
No.	Date	average 2-1	average 2-2	average 2-3	average 2-4	Average room 2	95 th percentile	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	720,607	858,113	854,253	878,400	827,843	875,357		
2	04/08/2011	313,327	336,493	336,933	363,693	337,612	359,679	515,678	58.91%
3	06/08/2011	143,740	140,440	146,933	142,520	143,408	146,454	728,903	83.27%
4	08/08/2011	660,480	702,107	730,253	735,247	707,022	734,498	140,859	16.09%
5	10/08/2011	198,753	216,967	213,500	216,873	211,523	216,953	658,404	75.22%
6	12/08/2011	232,340	232,300	239,367	252,000	239,002	250,105	625,252	71.43%
7	14/08/2011	393,013	393,233	398,487	380,860	391,398	397,699	477,658	54.57%
8	16/08/2011	337,387	588,893	583,107	586,887	524,068	588,592	286,765	32.76%
9	18/08/2011	37,973	44,560	46,740	50,887	45,040	50,265	825,092	94.26%
10	20/08/2011	41,900	46,840	50,960	53,040	48,185	52,728	822,629	93.98%
11	02/09/2011	175,613	212,773	188,500	177,087	188,493	209,132	666,225	76.11%
12	05/09/2011	138,680	162,733	176,353	182,353	165,030	181,453	693,904	79.27%

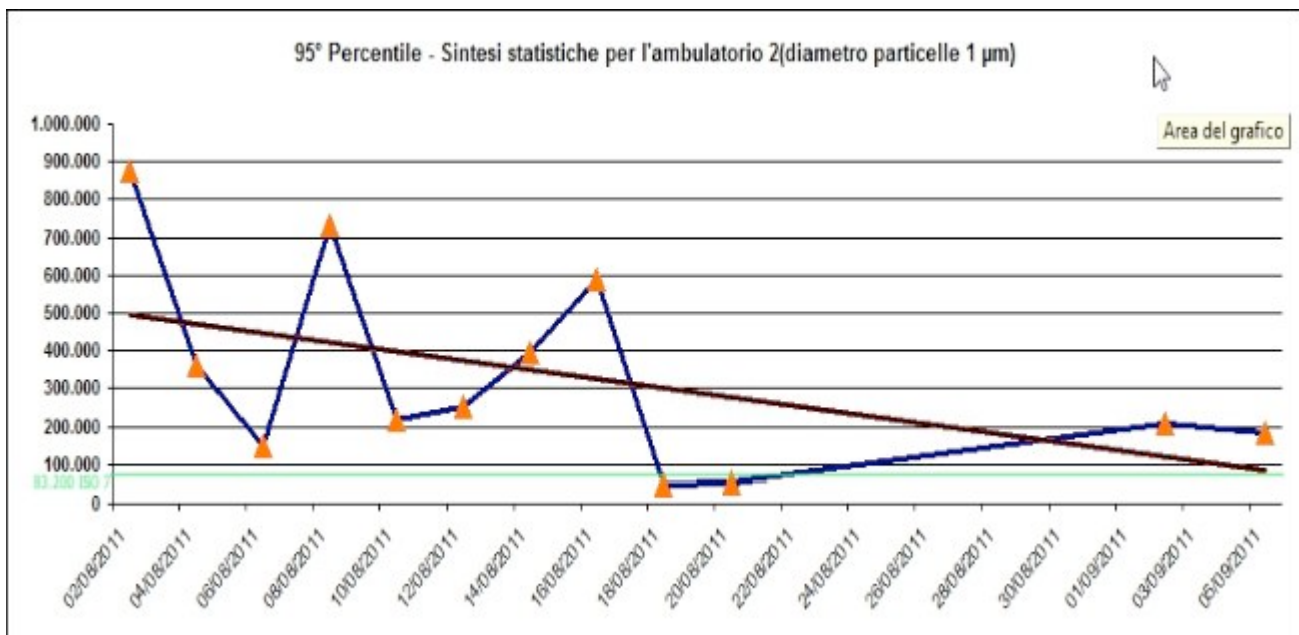


Fig 5.8 - Results of particle counting of room 2 for the particles with a diameter of 1 micron, in red tendency of the straight line, in the blue line that indicates the standard ISO-7

In relation to the monitoring of particulate contamination performed at the laboratory no. 2, examination of Tables 5.7 and 5.8 and the graphs in Fig.5.7 and 5.8, it is possible to conclude that, after a month of monitoring, the bioreactors used in surgeries have resulted in a progressive reduction in the presence of fine particles. In particular:

1. for what concerns the sieve fraction of 0.5  $\mu$ M, the monitoring data show a reduction percentage, calculated with respect to the data detected at the beginning of the experiment, which reached values higher than 94%;
2. for what concerns the sieve fraction equal to 1 micron, the monitoring data show:

- 2.1. a reduction percentage, calculated with respect to the data detected at the beginning of the experiment, which reached values higher than 94%;
- 2.2. and the achievement, in two successive measurements, of the standard ISO-7.

### 5.3.4.Reduction of airborne particles: summary of results obtained in room 3

The results of monitoring conducted in room 3 were synthesized:

1. for particles with a diameter of 0.5 µm:
  - 1.1. on a table showing for each of the dates of monitoring:
    - 1.1.1. the average of the measurements made in each of the 4 sampling points;
    - 1.1.2. the average for all measurements the room;
    - 1.1.3. the 95-th percentile on all measurements in the room.This figure, in accordance with the provisions of standard ISO 14644-1, is the value to be used to define the level of particulate contamination that characterizes environments subject of measures;
    - 1.1.4. the variation, calculated with respect to the initial starting value, of the data reported in the preceding paragraph.This change, expressed both in absolute and in percentage, provides a clear indicator of abatement obtained following the entry into operation of the CAP;
  - 1.2. in a graph (see Fig.5.9) in which are reported:
    - 1.2.1. the measurements, which indicate the steady reduction of bacterial colonies detected through particulate matter capture;
    - 1.2.2. The linear trend of the measurements.This line, obtained by interpolation of monitoring data, provides the performance of statistical measures;
2. the same also for the processing of the particles with a diameter of 1 micron.In particular:
  - 2.1. in Table 5.10, are highlighted in yellow the values that allow the achievement of ISO-7;
  - 2.2. the graph (see Fig.5.10) also contains the straight line which indicates the standard ISO-7 values.This representation allows to visually verify the attainment of the standard referred to above.

Tab.5.9 - Summary statistics for room 3 (particle diameter of 0.5 µm)									
No.	Date	average 3-1	average 3-2	average 3-3	Average 3-4	Average room 3	95 th percentile	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	5,969,647	6,946,873	11,152,780	15,579,633	9,912,233	14,915,605		
2	04/08/2011	3,900,513	3,624,427	3,330,893	3,663,513	3,629,837	3,864,963	11,050,642	74.09%
3	06/08/2011	1,486,840	1,504,647	1,696,060	1,583,560	1,567,777	1,679,185	13,236,420	88.74%
4	08/08/2011	9,726,053	10,064,727	10,819,153	9,110,853	9,930,197	10,705,989	4,209,616	28.22%
5	10/08/2011	1,105,780	1,129,260	1,141,913	1,072,347	1,112,325	1,140,015	13,775,590	92.36%
6	12/08/2011	1,943,720	1,982,380	2,073,400	2,070,927	2,017,607	2,073,029	12,842,576	86.10%
7	14/08/2011	2,875,867	2,852,473	2,881,107	2,855,173	2,866,155	2,880,321	12,035,285	80.69%
8	16/08/2011	1,828,460	1,789,740	1,846,027	1,798,280	1,815,627	1,843,392	13,072,214	87.64%
Providers	18/08/2011	1,656,080	1,620,027	1,575,420	1,524,007	1,593,883	1,650,672	13,264,933	88.93%
10	20/08/2011	664,813	662,160	669,507	677,707	668,547	676,477	14,239,129	95.46%
11	02/09/2011	1,467,887	1,549,713	1,432,087	1,389,373	1,459,765	1,537,439	13,378,166	89.69%
12	05/09/2011	1,155,847	1,243,767	1,398,120	1,409,107	1,301,710	1,407,459	13,508,147	90.56%

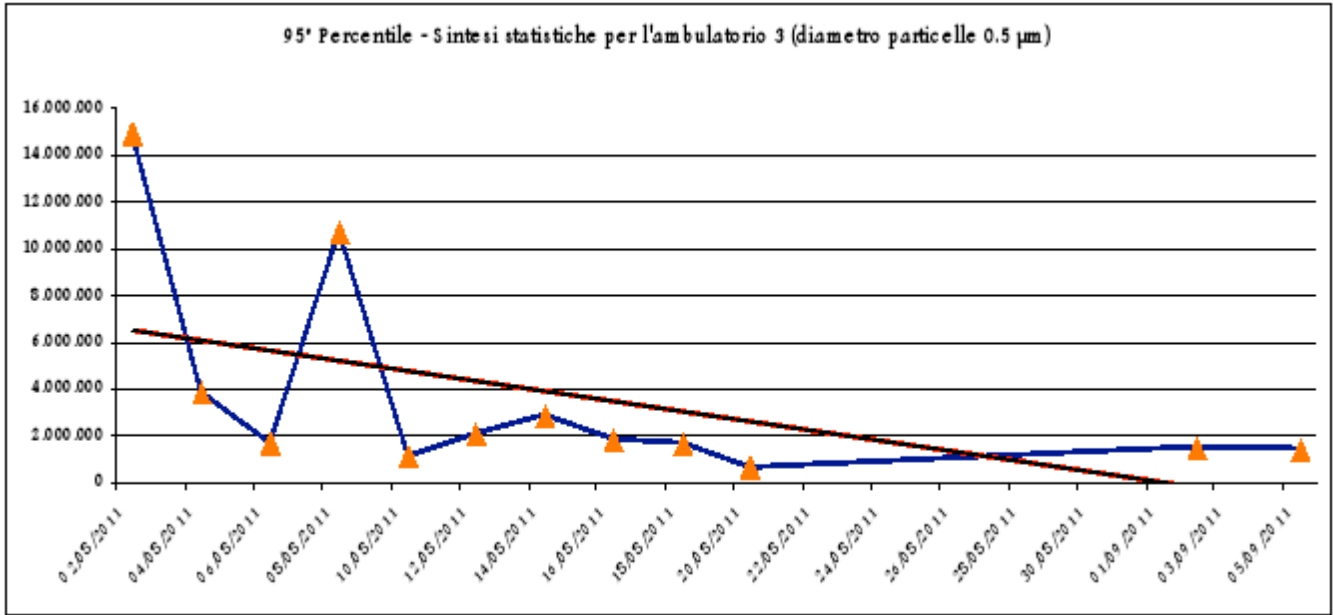


Fig 5.9 - Results of particle counting in room 3 for particles with a diameter of 0.5 µm, the trend line in red

Tab.5.10 - Summary statistics for room 3 (1 micron particle diameter)									
No.	Date	average 3-1	average 3-2	average 3-3	Average 3-4	Average room 3	95 th percentile	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	338,373	413,547	698,327	1,083,100	633,337	1,025,384		
2	04/08/2011	378,853	365,020	381,827	410,033	383,933	405,802	619,582	60.42%
3	06/08/2011	137,633	136,320	142,020	161,307	144,320	158,414	866,970	84.55%
4	08/08/2011	744,627	773,260	842,973	774,507	783,842	832,703	192,681	18.79%
5	10/08/2011	148,613	150,380	152,787	149,827	150,402	152,426	872,958	85.13%
6	12/08/2011	235,253	245,613	257,800	257,080	248,937	257,692	767,692	74.87%
7	14/08/2011	351,593	352,293	355,313	354,153	353,338	355,139	670,245	65.37%
8	16/08/2011	177,400	185,420	195,533	190,233	187,147	194,738	830,646	81.01%
9	18/08/2011	85,653	87,640	82,807	89,433	86,383	89,164	936,220	91.30%
10	20/08/2011	42,680	49,087	55,807	59,387	51,740	58,850	966,534	94.26%
11	02/09/2011	129,573	142,387	155,347	148,393	143,925	154,304	871,080	84.95%
12	05/09/2011	146,160	169,427	199,293	214,853	182,433	212,519	812,865	79.27%

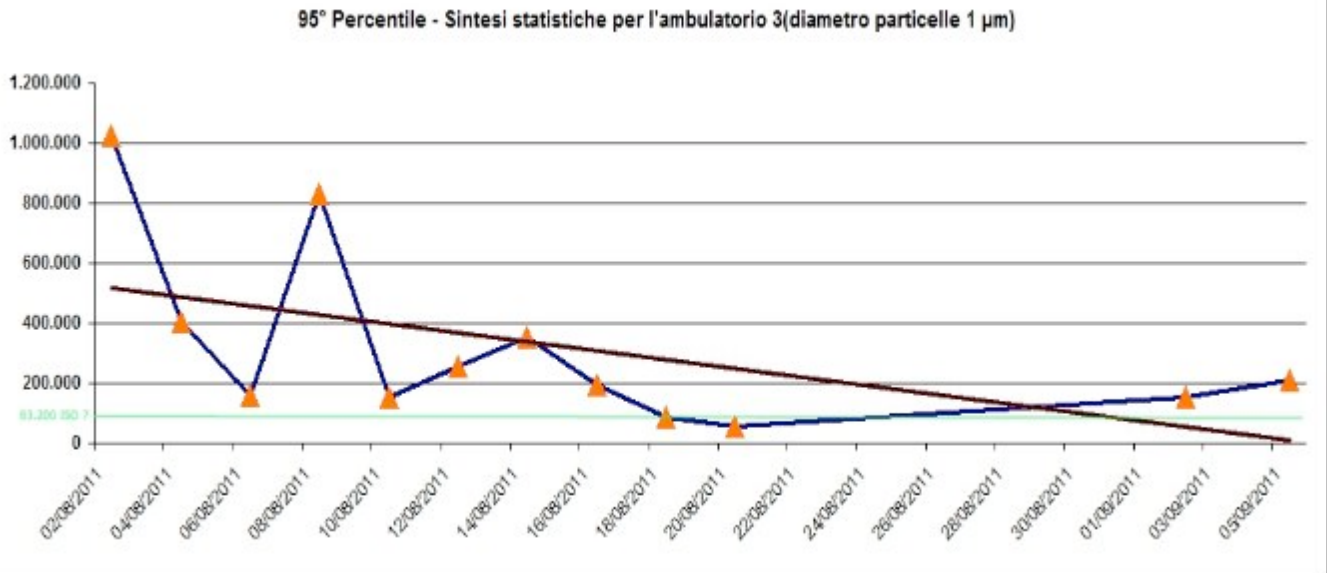


Fig 5.10 - Results of particle counting in room 3 for the particles with a diameter of 1 micron, in red tendency of the straight line, in the blue line that indicates the standard ISO-7

In relation to the monitoring of particulate contamination performed in room no. 3, examination of Tables 5.9 and 5.10 and from the graphs in Fig.5.9 and 5.10, **you can conclude that**, after a month of monitoring, the bioreactors used in visiting rooms **have resulted in a progressive reduction in the presence of fine particles. In particular:**

1. for what concerns the sieve fraction of 0.5 µm, the monitoring data show a reduction percentage, calculated with respect to the data detected at the beginning of the experiment, which reached values higher than 94%;
2. for what concerns the sieve fraction equal to 1 micron, the monitoring data show:
  - 2.1. a reduction percentage, calculated with respect to the data detected at the beginning of the experiment, which reached values higher than 94%;
  - 2.2. and the achievement, in one measurement, of the standard ISO-7.

### 5.3.5.Reduction of airborne particles: summary of results obtained in room 4

The results of monitoring conducted in room 4 were synthesized:

1. for particles with a diameter of 0.5 µm:
  - 1.1. on a table showing for each of the dates of monitoring:
    - 1.1.1. the average of the measurements made in each of the 4 sampling points;
    - 1.1.2. the average for all measurements the room;
    - 1.1.3. the 95-th percentile on all measurements in the room. This figure, in accordance with the provisions of standard ISO 14644-1, is the value to be used to define the level of particulate contamination that characterizes environments subject of measures;
    - 1.1.4. the variation, calculated with respect to the initial starting value, of the data reported in the preceding paragraph. This change, expressed both in absolute and in percentage, provides a clear indicator of abatement obtained following the entry into operation of the CAP;
  - 1.2. in a graph (see Fig.5.11) in which are reported:



1.2.1. the measurements, which indicate the steady reduction of bacterial colonies detected through particulate matter capture;

1.2.2. The linear trend of the measurements. This line, obtained by interpolation of monitoring data, provides the performance of statistical measures;

2. the same also for the processing of the particles with a diameter of 1 micron. In particular:

2.1. in Table 5.12, are highlighted in yellow the values that allow the achievement of ISO-7;

2.2. the graph (see Fig.5.12) also contains the straight line which indicates in the standard ISO-7. This representation allows to visually verify the attainment of the standard referred to above.

Tab.5.11 - Summary statistics for room 4 (particle diameter of 0.5 µm)									
No.	Date	average 4-1	average 4-2	average 4-3	average 4-4	Average room 4	95 th percentile	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	9,326,607	10,777,533	9,064,480		9,722,873	10,632,441		
2	04/08/2011	3,326,280	3,074,967	3,042,527	2,920,133	3,090,977	3,288,583	7,343,858	69.07%
3	06/08/2011	1,507,027	1,517,113	1,699,740	1,854,580	1,644,615	1,831,354	8,801,087	82.78%
4	08/08/2011	13,089,440	13,649,573	13,477,393	13,231,667	13,362,018	13,623,746	-2,991,306	-28.13%
5	10/08/2011	1,261,687	1,063,913	985,013	990,760	1,075,343	1,232,021	9,400,420	88.41%
6	12/08/2011	2,248,807	2,049,927	1,870,980	1,754,333	1,981,012	2,218,975	8,413,466	79.13%
7	14/08/2011	2,398,420	2,419,753	2,399,373	2,412,567	2,407,528	2,418,675	8,213,765	77.25%
8	16/08/2011	13,004,007	12,961,727	11,814,400	11,488,740	12,317,218	12,997,665	-2,365,224	-22.25%
9	18/08/2011	3,141,920	3,259,880	3,331,193	2,694,707	3,106,925	3,320,496	7,311,944	68.77%
10	20/08/2011	665,960	688,627	723,633	739,300	704,380	736,950	9,895,491	93.07%
11	02/09/2011	3,297,053	3,506,327	3,210,560	3,256,773	3,317,678	3,474,936	7,157,505	67.32%
12	05/09/2011	4,888,027	4,639,080	3,682,173	3,263,587	4,118,217	4,850,685	5,781,756	54.38%

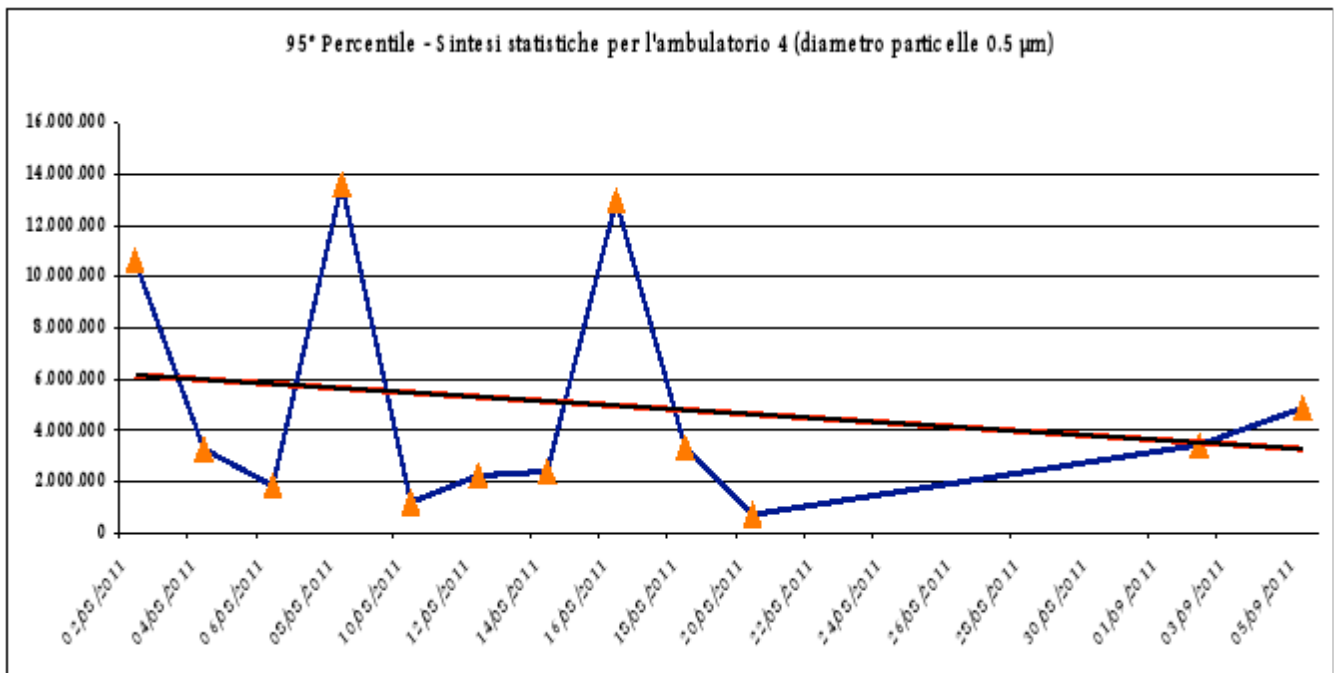


Figure 5.11 - Results of particle counting in room 4 for particles with a diameter of 0.5 µm, the red trend line

Tab.5.12 - Summary statistics for room 4 (1 micron particle diameter)									
No.	Date	average 4-1	average 4-2	average 4-3	average 4-4	Average room 4	95 th percentile	Change compared to the first measurement	Percentage change with respect to the first measurement
1	02/08/2011	576,560	748,407	599,860		641,609	733,552		
2	04/08/2011	379,267	364,427	345,907	302,140	347,935	377,041	356,511	48.60%
3	06/08/2011	153,527	146,813	150,573	156,087	151,750	155,703	577,849	78.77%
4	08/08/2011	965,340	1,000,027	992,053	967,053	981,118	998,831	-265,279	-36.16%
5	10/08/2011	208,147	177,760	163,020	159,087	177,003	203,589	529,963	72.25%
6	12/08/2011	306,840	272,927	248,200	249,767	269,433	301,753	431,799	58.86%
7	14/08/2011	278,013	282,993	315,060	328,640	301,177	326,603	406,949	55.48%
8	16/08/2011	3,126,720	3,045,413	2,713,353	2,554,273	2,859,940	3,114,524	-2,380,972	-324.58%
9	18/08/2011	245,700	264,040	267,587	221,253	249,645	267,055	466,497	63.59%
10	20/08/2011	61,847	77,193	106,013	85,700	82,688	102,966	630,586	85.96%
11	02/09/2011	415,733	432,927	428,167	428,087	426,228	432,213	301,339	41.08%
12	05/09/2011	439,060	454,560	430,207	384,047	426,968	452,235	281,317	38.35%

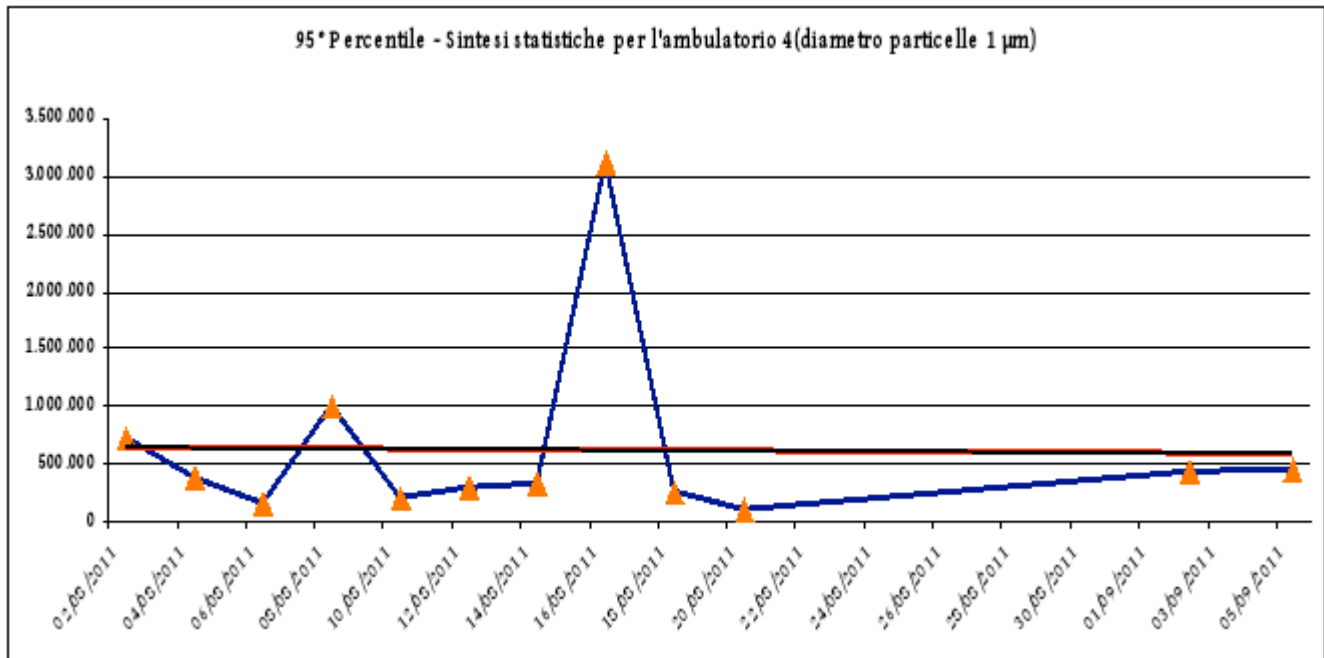


Fig 5.12 - Results of particle counting in room 4 for the particles with a diameter of 1 micron, in red tendency of the straight line,

In relation to the monitoring of particulate contamination performed at the laboratory no. 4, examination of Tables 5.11 and 5.12 and from the graphs in Fig.5.11 and 5.12, you can conclude that, after a month of monitoring, bioreactors used in visiting rooms have resulted in a progressive reduction in the presence of fine particles. In particular:

1. for what concerns the sieve fraction of 0.5  $\mu\text{m}$ , the monitoring data show a reduction percentage, calculated with respect to the data detected at the beginning of the experiment, which reached values higher than 85%. Exceptions are the measurements from the date 08/08/2011 and 16/08/2011. In such cases, peak concentrations were observed whose causes are deep cleaning activity was performed just before the testing was done using disinfectant products.

2. for what concerns the sieve fraction equal to 1 micron, the monitoring data show a reduction percentage, calculated with respect to the data detected at the beginning of the experiment, which reached values higher than 85%. Exceptions are the measurements from the date 08/08/2011 and 16/08/2011. In such cases, peak concentrations were observed whose causes are mentioned above.

## 6. Conclusions

In relation to the monitoring of bacterial contamination carried out at the clinics involved in the testing, examination of the data contained in this document, **you can conclude that**, after less than a month of monitoring, the bioreactors used in the rooms, **have led to a progressive reduction in the number of bacterial colonies with a percentage of reduction, calculated with respect to the data detected at the beginning of the experiment, which are generally higher than 95%.**

In relation to the monitoring of particulate contamination made in the visiting rooms involved in the testing, examination of the data contained in this document, **you can conclude that**, after a month of monitoring, the bioreactors used in the rooms **have resulted in a progressive reduction of the presence of fine particles. In particular:**

1. for what concerns the sieve fraction of 0.5  $\mu\text{M}$ , the monitoring data show a reduction percentage, calculated with respect to the data detected at the beginning of the experiment, which has reached, in general, values higher than 90%;
2. for what concerns the sieve fraction equal to 1 micron, the monitoring data, in general, show:
  - 2.1. a reduction percentage, calculated with respect to the data detected at the beginning of the experiment, which reached values close to 90%;
  - 2.2. and the achievement, for some measurements, the standard ISO-7.

### Contact Us

For any clarification or agreements relating to this proposal for testing the referees for U-Earth are:

Sara Zanni

ricerca@u-earth.eu

Betta Maggio

betta.maggio @ u-earth.eu

[www.u-earth.eu](http://www.u-earth.eu)

Turin, June 8, 2011

