QUERINI FOUNDATION - "PARADISO" STORAGE
TESTING THE EFFICIENCY OF THE AIR TREATMENT DEVICE *INT4SAN*

PREMISES

The storage is placed in Venice, on the ground floor and one of the walls is directly on the channel (north estern wall). The storage is composed by two symmetrical rooms communicating through a hall with no door. (**attached 1**). At the moment of the site inspection, 20/12/2021, there were no humidity control devices working. There are insulating polyethylene sheets between the walls and the shelving, the goods are on the 2nd shelves (circa 30 cm to over the floor).

Image 1: Entry that communicates the 2 rooms (left), entrance (south eastern wall) during the monitoring with SAS-IAQ Device.

REMEDIATION WORK

The monitoring precedes and follows the placement of an environment purifier composed by a dehumidification ,filtration and cleansing system (image 2)

The device has been placed in Room n.2, near the northeastern wall (**attached 1**) and put in use on the 20/01/2022, one month after the first tracking. There have been no changes on the archive workers routine since the device has been operating.

Image 2: Air Treatment Device placed in Room 2

SAMPLING

AIR

The air sampling has been made by a positive displaced pump SAS-IAQ, using growth medias specific for fungal and aerobic heterotrophic bacterial loads.
They has been sampling 4 sites inside the 2 rooms and 1 outside (control). In all the sites they has been withdrawn 150Lt of air trough active aspiration.
The first tracking (before the remediation) took place on the 20/12/2021, the second one (after remediation) on the 24/02/2022, circa one month after the put in use of the device.

Site	Room	Area
01	Interior Room 1	Entrance (south eastern area) between two shelvings
02	Interior Room 1	Wall bording with Room 2 (south western area) between two shelvings
03	Interior Room 2	Next to the boat access (north eastern area) between two shelvings
04	Interior Room 2	Wall opposite to the boat access (north western area) between two shelvings

05	Exterior (control)	Facing the entrance, close to the channel

CLIMATE MONITORING

T (temperature) and the RH (relative humidity) had been tracked continuously from the 20/12/2021 to the 24/02/2022 with thermohygrometric data-logger placed in both rooms.

Data-logger position

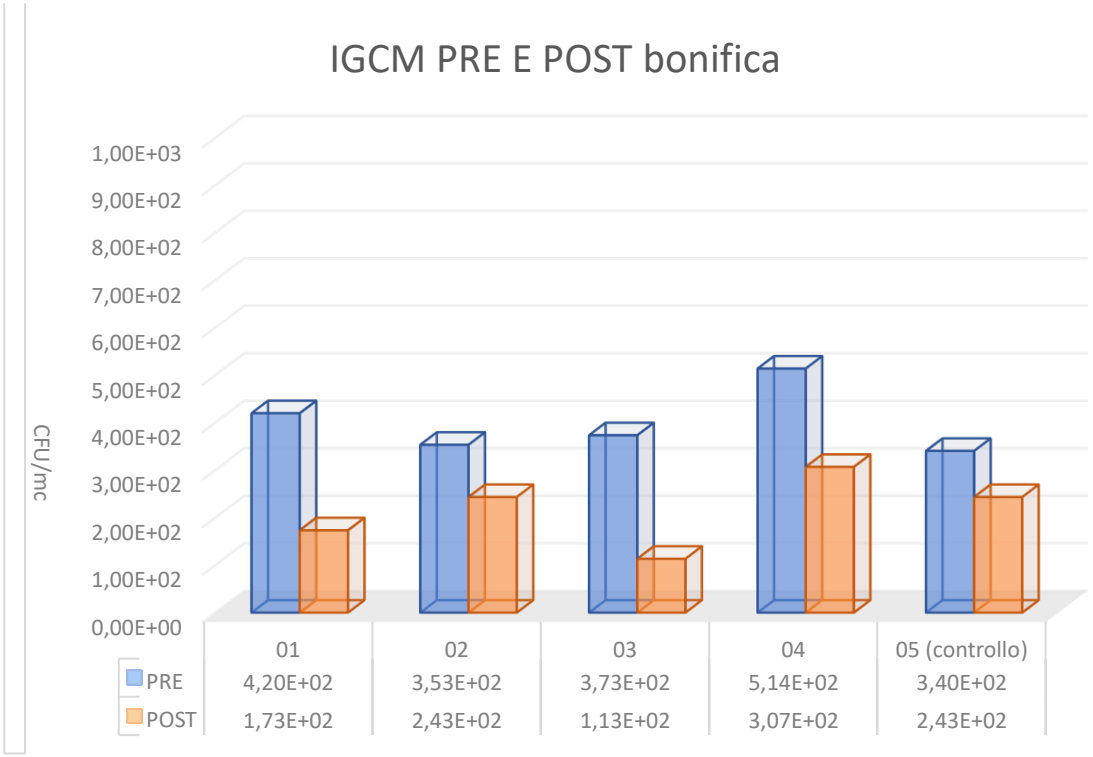
Probe 2 (code 00566): Room 1, Shelving E, Shelf 12
Probe 3 (data 01) : Room 1, Shelving F, Shelf 6
Probe 4 (RHTO-03): Room 2, Shelving I, Shelf 1
Probe 6 (1366): Room 2, Shelving Q, Shelf 11

MICROBIOLOGICAL AIR ANALISYS

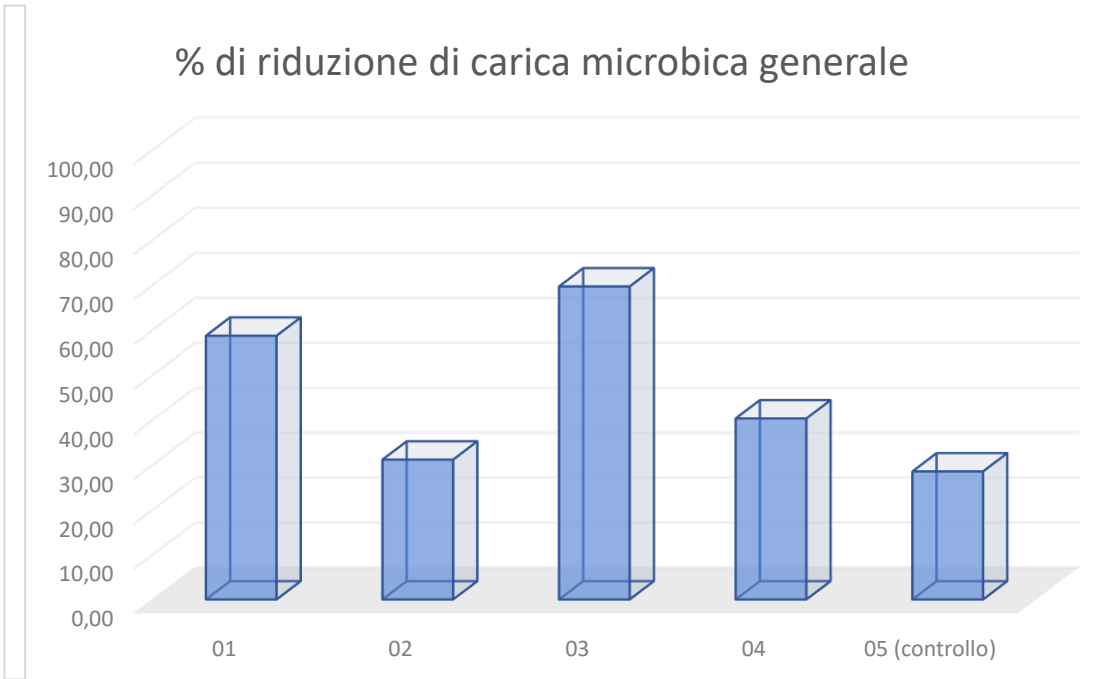
The air extracted by SAS-IAQ device has been sampled on agar culture media specific for total fungi(DRBC) and bacteria (LB) as the INAIL (National Assurance Institute for Working Injuries) guidelines for environment biological sampling says, and adding another kind of culture media (DG18) specific for xerophile fungus that are often present in indoor preservation venues.
The agar plates had been incubated 3 to 7 days in a 20-22 C° dark environment for the molds, and at 37C° for mesophile bacterias. Each sampling site has been replied two times.
Once the incubation ended the colony forming units (CFU) had been listed reporting the values per cubic meter. The number of the colonies has been revised to obtain the value MPN (Most Probable Number) following the sampling device manual directions. The benchmark is expressed by CFU/cu.m. From bacterial and fungal FCU we can get several indexes (Dacarro Indexes: MCGI microbial contamination general index, AI amplification index (difference between interior and exterior contamination), MI mesophiles index) expression of the microbiological air quality (INAIL guidelines)

RESULTS

Microbial Contamination General Index (MCGI) before and after remediation work. **Chart 1**



Microbial load dropping percentage. **Chart 2**



Fungal contamination load before and after the remediation work. **Chart 3**

Contaminazione fungina totale pre e post bonifica

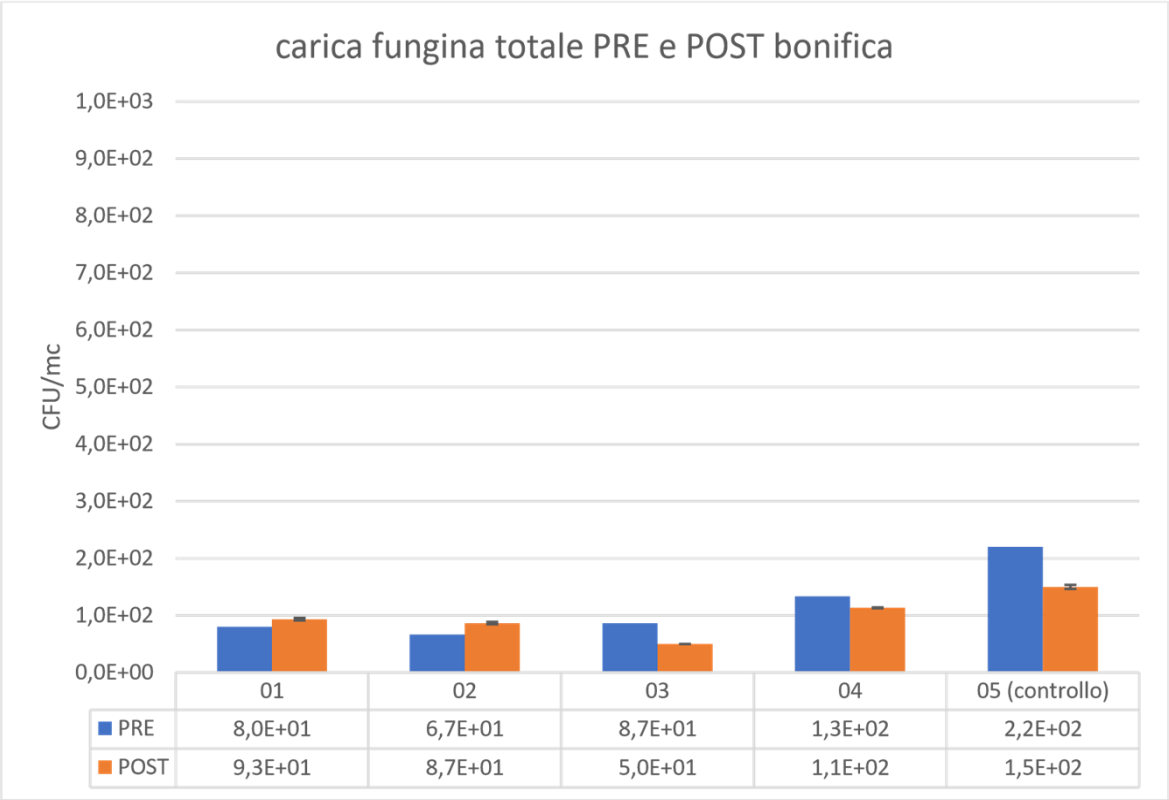


Grafico 3

Xerophile fungal contamination before and after the remediation work. **Chart 4**
Contaminazione funghi xerofili pre e post bonifica

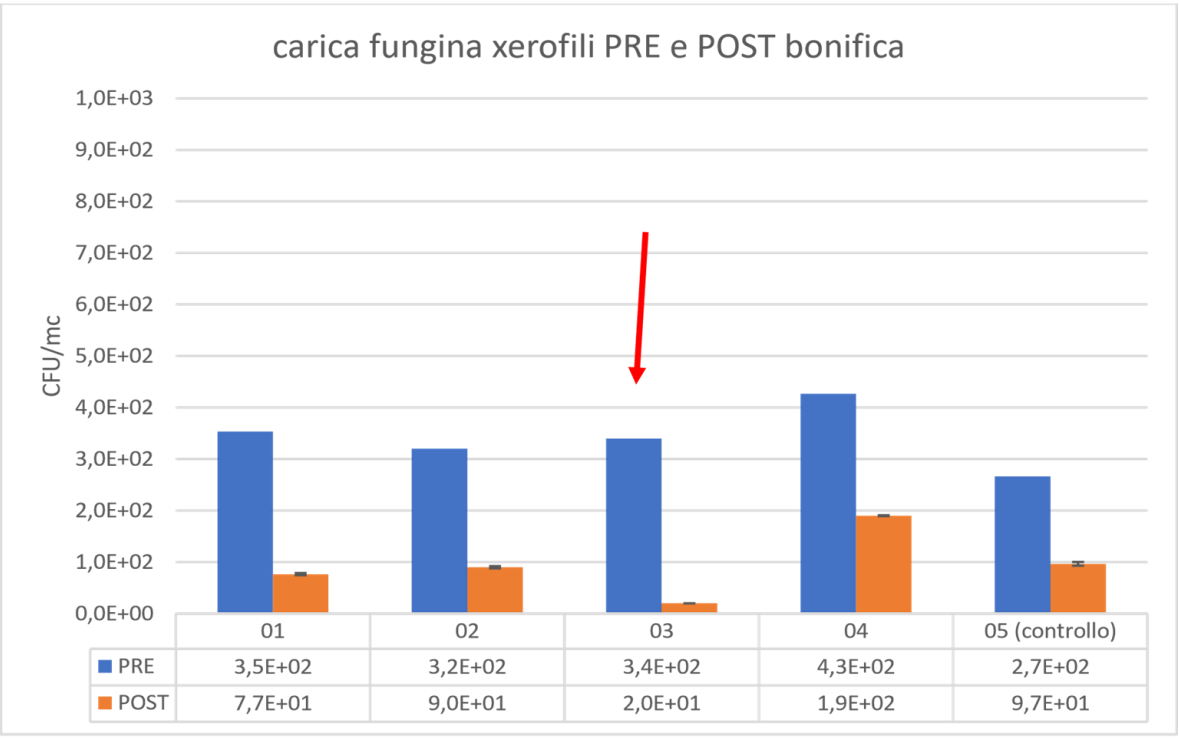


Grafico 4

Xerophil fungal load dropping percentage. **Chart 5**

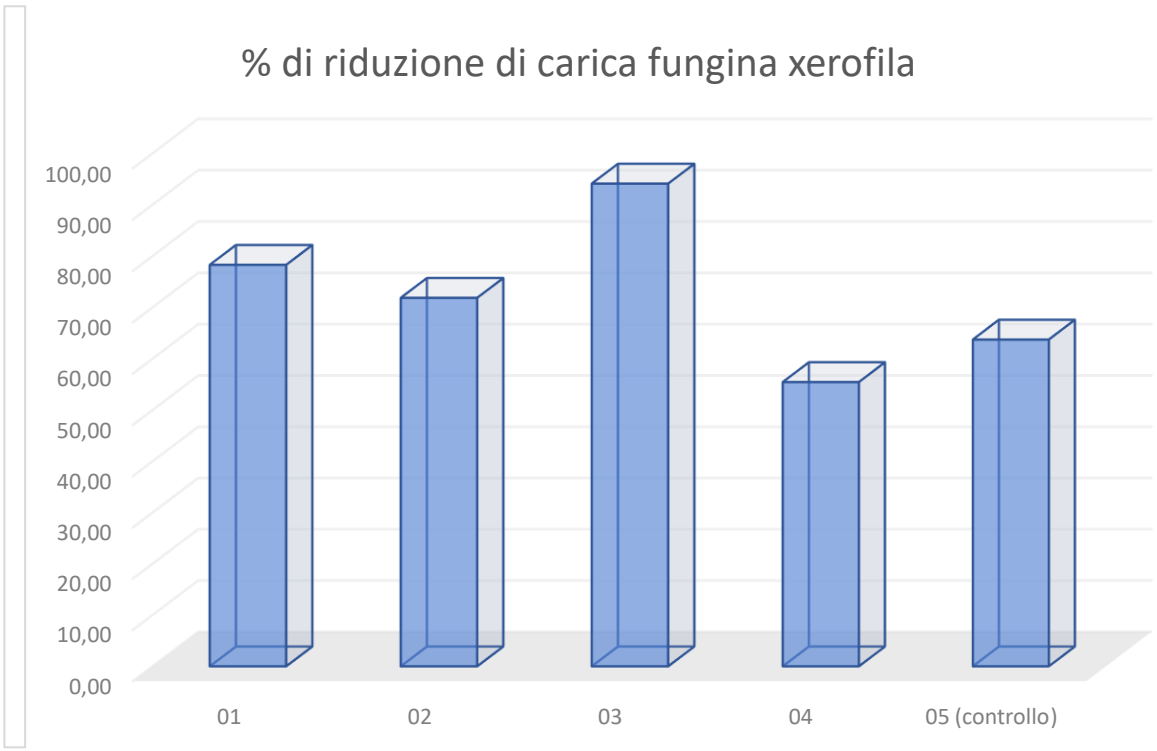


Grafico 5

Bacteria contamination before and after remediation work. **Chart 6**
Contaminazione batterica pre e post bonifica

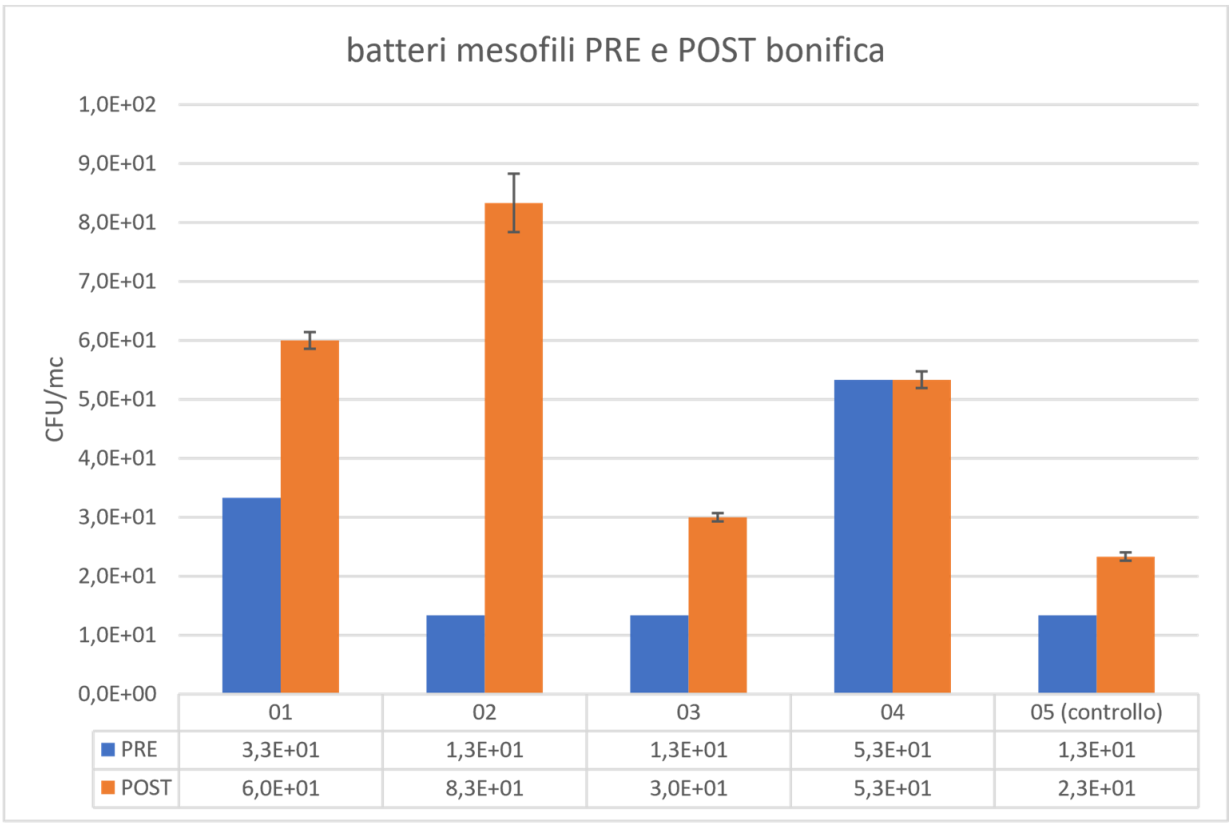


Grafico 6

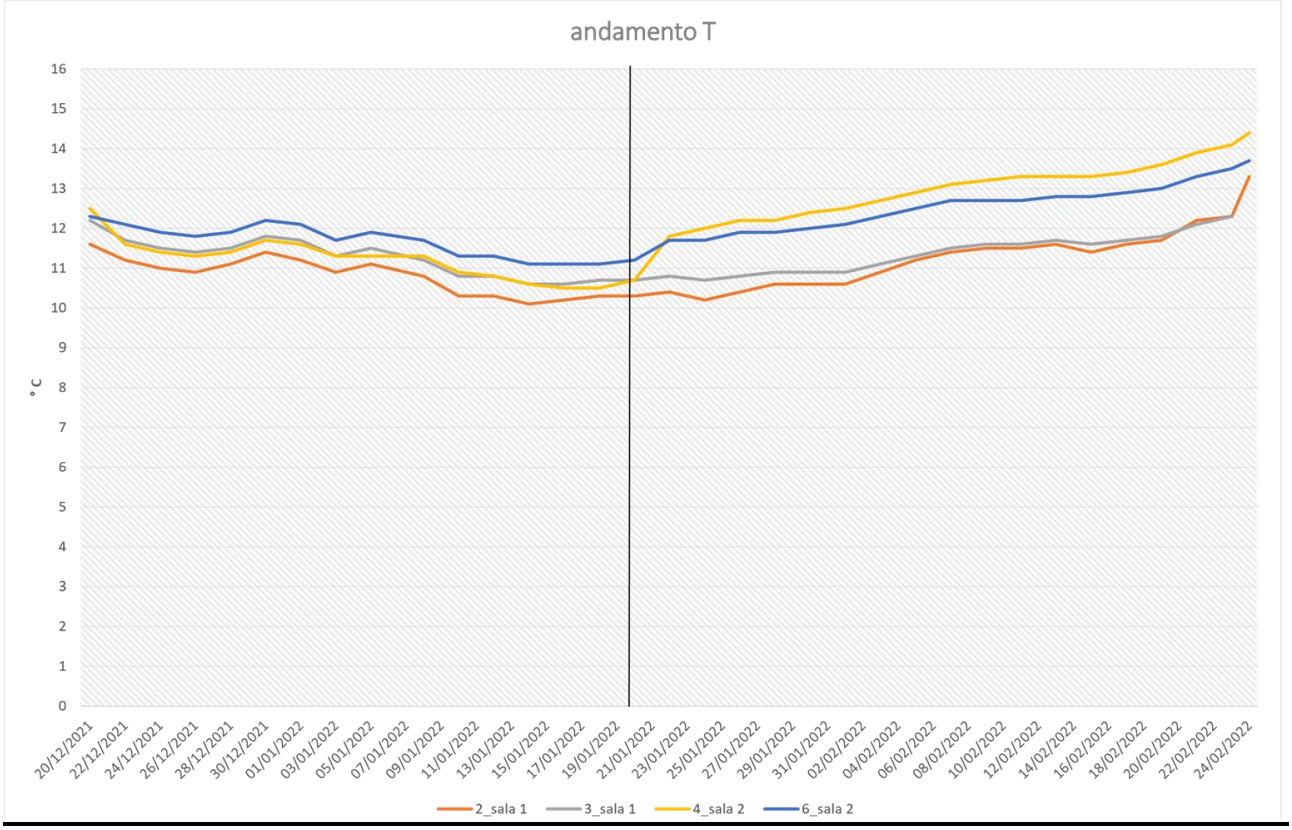
MICROBIOLOGICAL AIR ANALISYS RESULTS DISCUSSION

The MCGI tells the health and hygiene status of the air in the two rooms before and after the

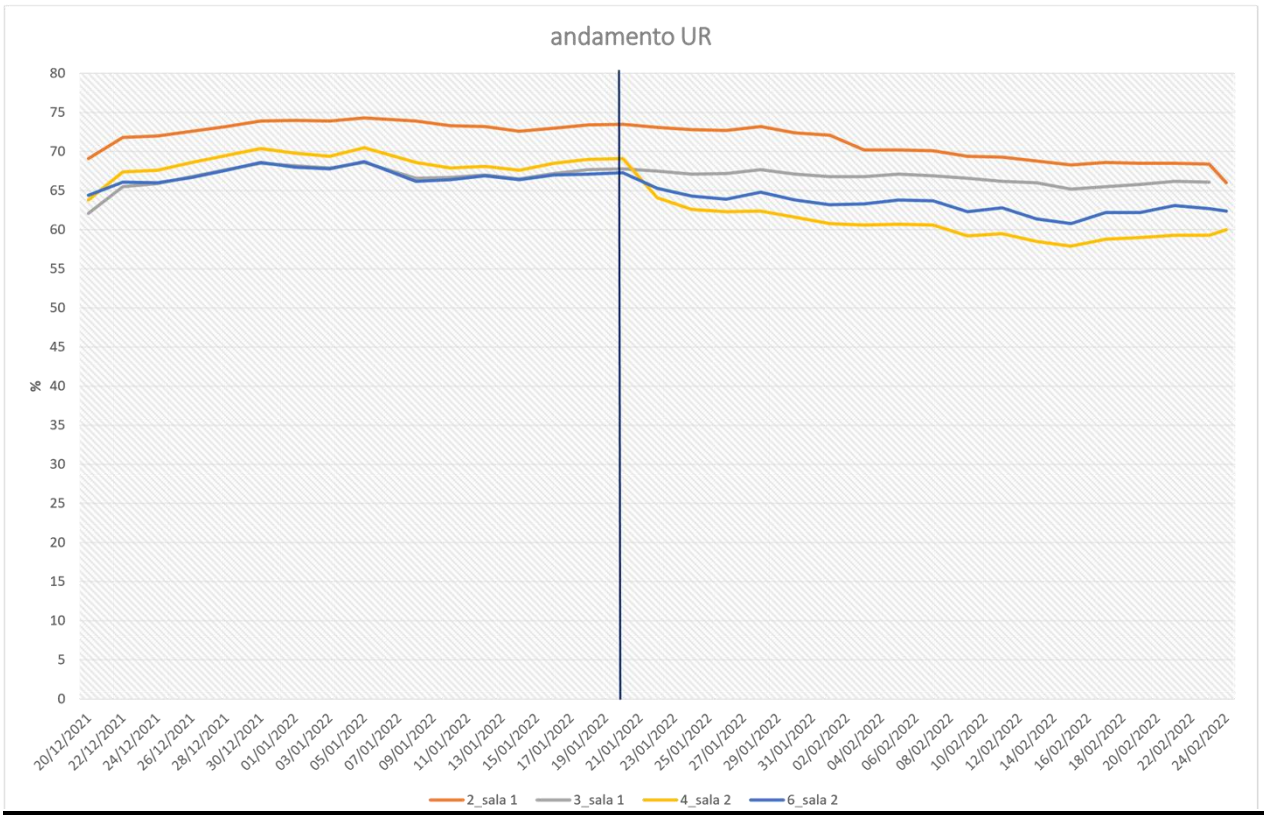
placement of air treatment device.
The data show a generalized decrease of the microbiological load, even in the control site (Chart 1).
The reduction of the charge, changes based on the place of site of sampling, and it is more evident on the site number 03 (**Chart 2**), the closest to the purifier.
Concerning the load sampled on agar selective (DRBC) for total fungi, the decrease is not that strong: in Room 1 we can see an increasing of psicrophiles fungi, due to external proximity, and a light decrease in the Room 2, where the device is placed. (**Chart 3**)
The xerophile component, which is the most present in indoor preservation sites, is the component subjected to the biggest drop as it is clear on the sample 03. In this case we can see a drop near to 70% . (**Chart 4**)
The bacterial component of the air, barely representative even before the remedy, is not subjected to any important variation. The light increase of mesophiles bacterias, clearly visible on sample 02, (**Chart 6**) tracked after the remediation, is due to the presence of people inside Room 1 before the air sampling.

MICROCLIMATE

comparison of temperature trend inside the two rooms



Comparison of RH tremd in the two rooms


andamento UR
%
2_sala 1
3_sala 1
4_sala 2
6_sala 2

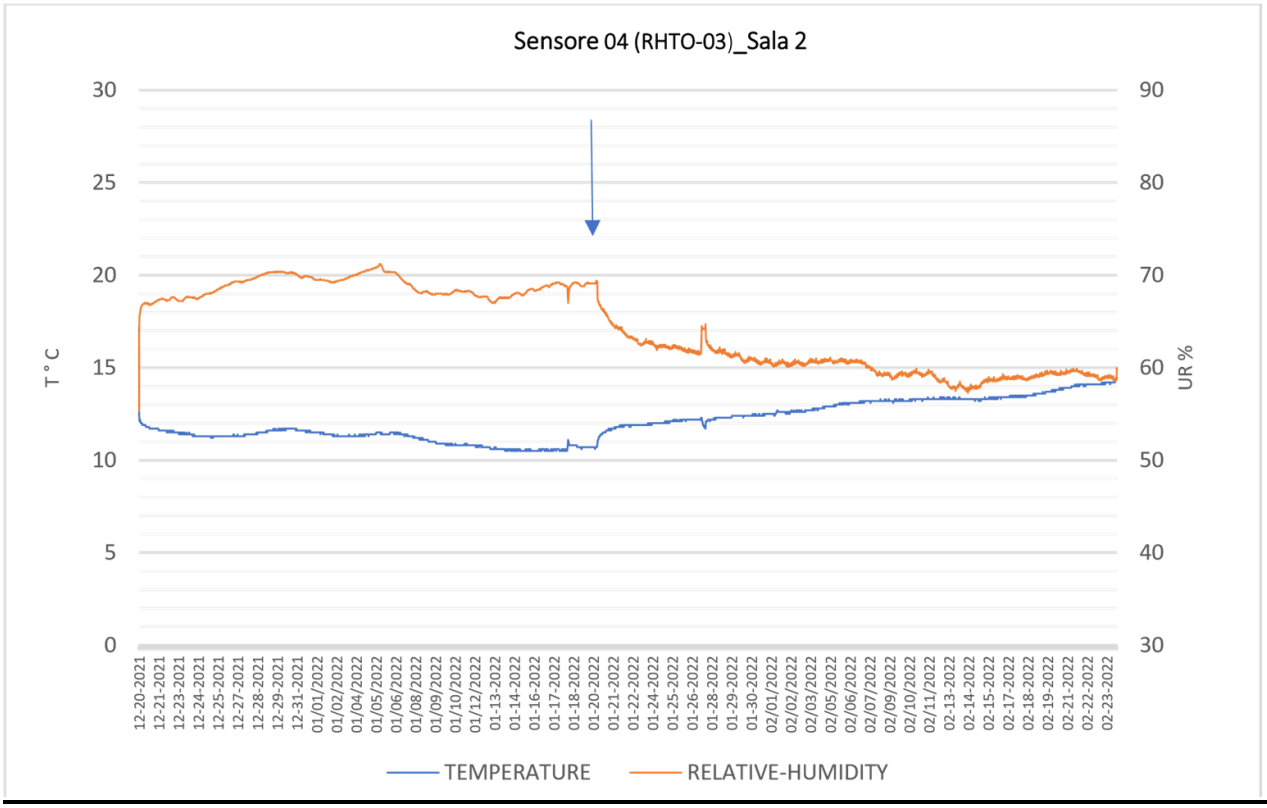

Sensore 04 (RHTO-03)_Sala 2
T ° C
UR %
TEMPERATURE
RELATIVE-HUMIDITY

Chart 9: Simultaneous trend of T and RH of probe 06 in Room 2 over time

MICROCLIMATE RESULT DISCUSSION

Thermohygrometric air conditions in Room 2 had strongly been influenced by the put in use of the air treatment device, as seen on the data of the data-loggers placed in between the shelving (**Attached 1**).

The charts 6A and **7** show the Temperature an RH trend, with a strong progressive decrease of the RH tracked by the probe 04 and 06, after the switching on of the purifier.
The effect is clear in the **Chart 8** where it is seen, over time, the simultaneous trend of T and RH of probe 04, placed close to the device.
After the switching on (20/01/2022) of the purifier, we assist to a drastic drop of the RH , from 70% to 65% in one hour followed by a 1 C° degree increase of the temperature. RH and T trends keep going on the same until the highest peak of 14.4 C° and 58% RH. Also seen on Chart 9.

CONCLUSION

The aerial microbial load of the storage comply with the guidelines from INAIL (National Assurance Institute for Working Injuries).
Nevertheless we need to notice that the values written in such guidelines are related to standard working environments, with constant human attendance, but we have to keep in consideration that the environment monitored is an archival storage occasionally attended by the staff.
So , in this case, 1st) the comparison between the 2 rooms and the external control point, and 2nd) the quality analysis of the microbiological component, can lead to more detailed information.
The air treatment device has surely reduced the microbial load, especially for the xerophile component, that is the more representative in archival and library indoor storage. The maximum reduction is seen in the sample site that was closer to the device.
The dehumidifying action of the devices clearly reduced the RH in the storage where it have been placed, the maximum results is seen in the sample that was closer to the machine.

bi◎res

Dr. Matteo Montanari