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MULTIDIMENSIONAL INTEGRATED QUANTITATIVE APPROACH TO ASSESS SAFETY AND SUSTAINABILITY OF NANOMATERIALS IN REAL CASE LIFE CYCLE SCENARIOS USING NANOSPECIFIC IMPACT CATEGORIES

WP2

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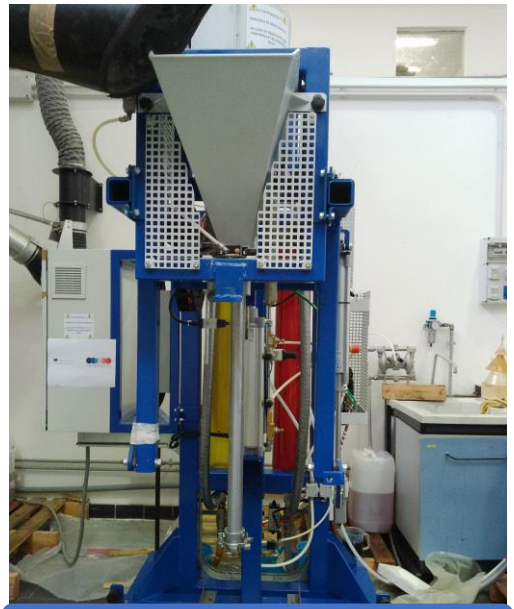
Task 2.4.2

Pilot Line: Low Density Casting Machine of CNR-IPCB

Processes Analyzed (in Triplicate):

- Bio-SiO2@F/Diatomite & Mould without Lid Configuration (x3) April the 16th
- Bio-SiO2@F/Gas Beton & Mould without Lid Configuration (x3) April the 17th
- Bio-SiO2@F/Gas Beton & Mould with Lid Configuration (x3) April the 18th
- Bio-SiO2@F/Diatomite & Mould with Lid Configuration (x3) April the 19th

Total Processes Measured: 12, plus the background taken during the breaks and one night.



Casting Machine

Measurement Phases:

- Weighing Phase
- Loading Phase
- Casting Phase

Field Campaign **I**) : April from the 16th to the 19th

- Cutting Phase

Field Campaign **II**): one dedicated day on April the 22th

Focus: Identify whether a process is associated with lower emissions, particularly during the casting.

Sequence of the operations:

In the room: arm fume extractors all around, plus some windows at the top.

i) Weighing : around 5/10 minutes.
ii) Mixing and Loading : around 3/5 minutes.
iii) Casting : less than one minute.
iv) Growth of the foam : ten minutes (mould with/without the lid configuration)
v) Cleaning : 15/30 minutes (postponed and excluded from the analysis).

weighing

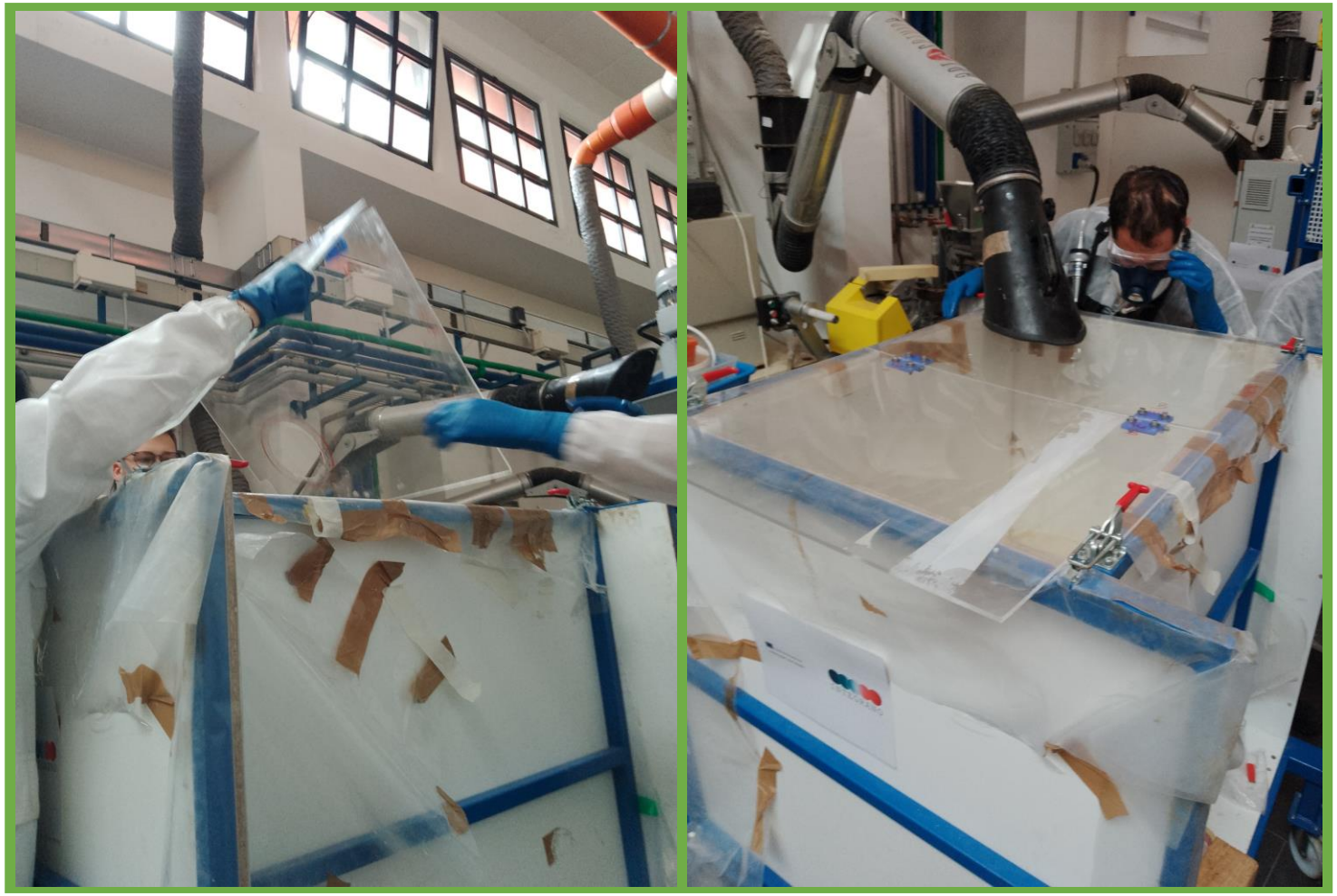
mixing and loading

casting and foam growth

cleaning

Mould without Lid

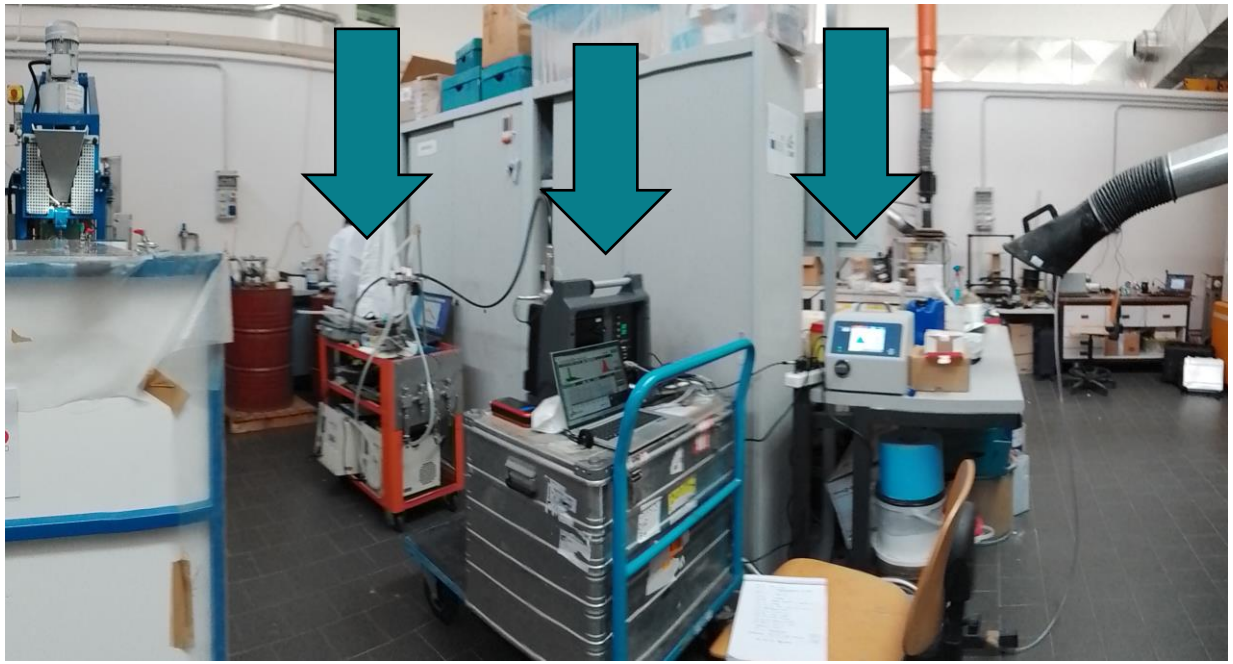
Mould with Lid Configuration



Field Campaign I) :

Near Field (NF) Instruments

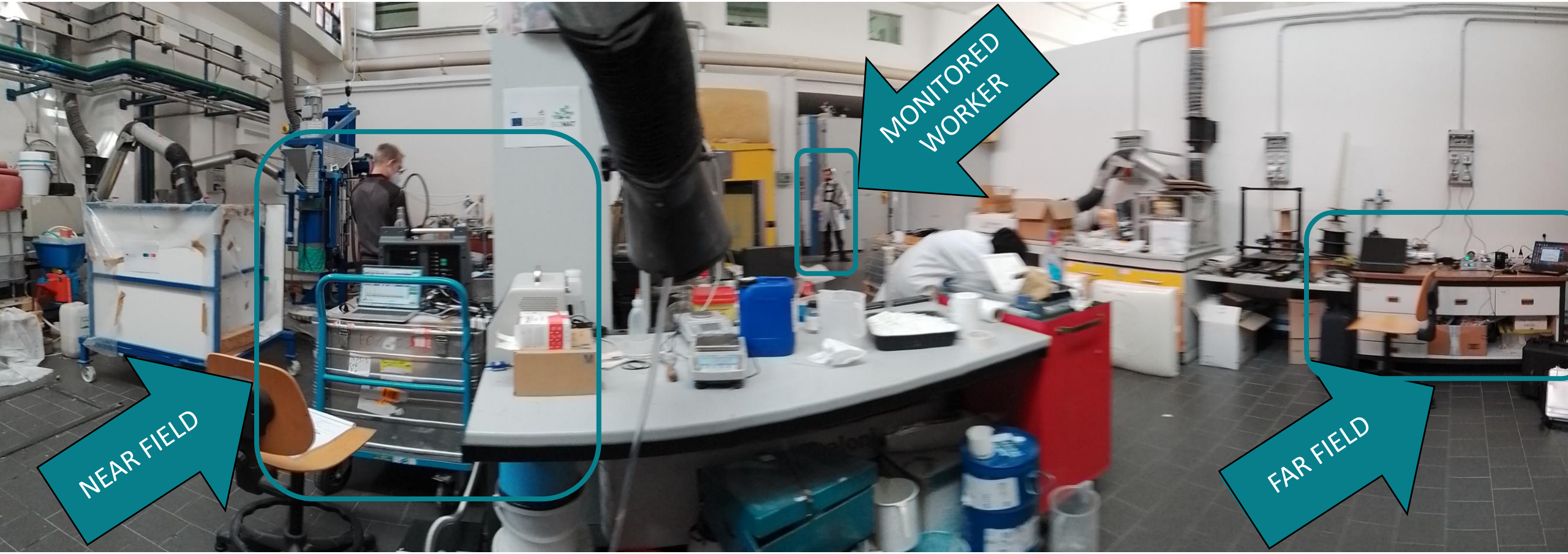
- OPC 11-A, Grimm (CNR-ISAC)
- Nucleopore filter for SEM analyses (CNR-ISAC)
- Teflon filter for gravimetric analyses (CNR-ISAC)
- T and RH sensor GSP-6, Elitech (CNR-ISAC)
- Partector, Naneos (CNR-ISAC & UNIMIB)
- ELPI+, Dekati (UNIMIB)
- Nanoscan SMPS, TSI (UNIMIB)
- Diffusion Size Classifier DiSCmini, Testo (UNIMIB)



Strategy:

- Instruments closed to both the casting machine and the weighing area.
- Fast processes require fast instruments: instead of SMPS (CNR-ISAC) there was ELPI+ (UNIMIB) set at 1Hz, 1s interval.

Field Campaign I) :



Field Campaign I) :

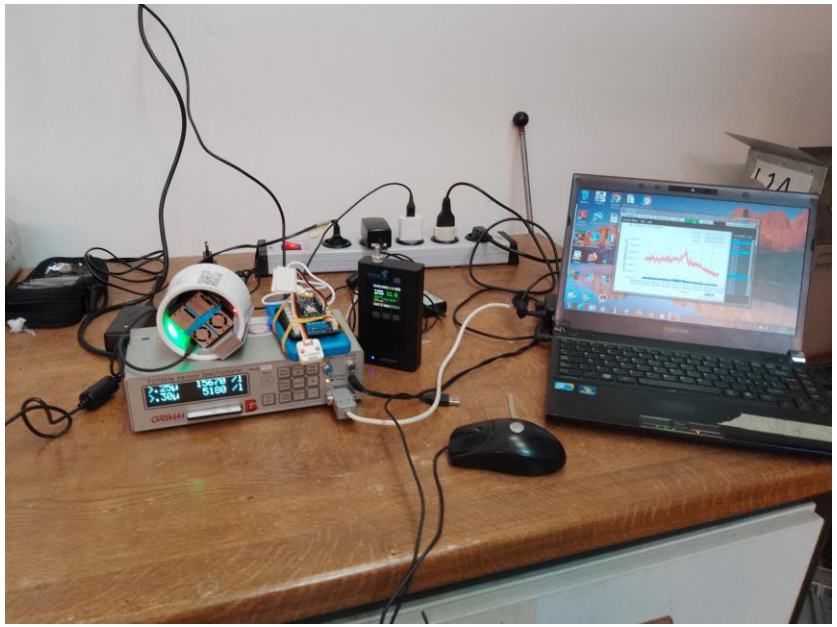
Far Field (FF) Instruments

- OPC 11-D, Grimm (CNR-ISAC)
- Partector, Naneos (CNR-ISAC)
- Air Quality Monitor, PurpleAir (UNIMIB)

Personal exposure monitoring (worker)

- Diffusion Size Classifier DiSCmini, Testo (CNR-ISAC)
- Portable PM Sampler, SKC Leland Legacy (CNR-ISAC)

The same worker kept the equipment for a continuous period of four days during the 8-hour work shift.
Each day a different filter was sampled.



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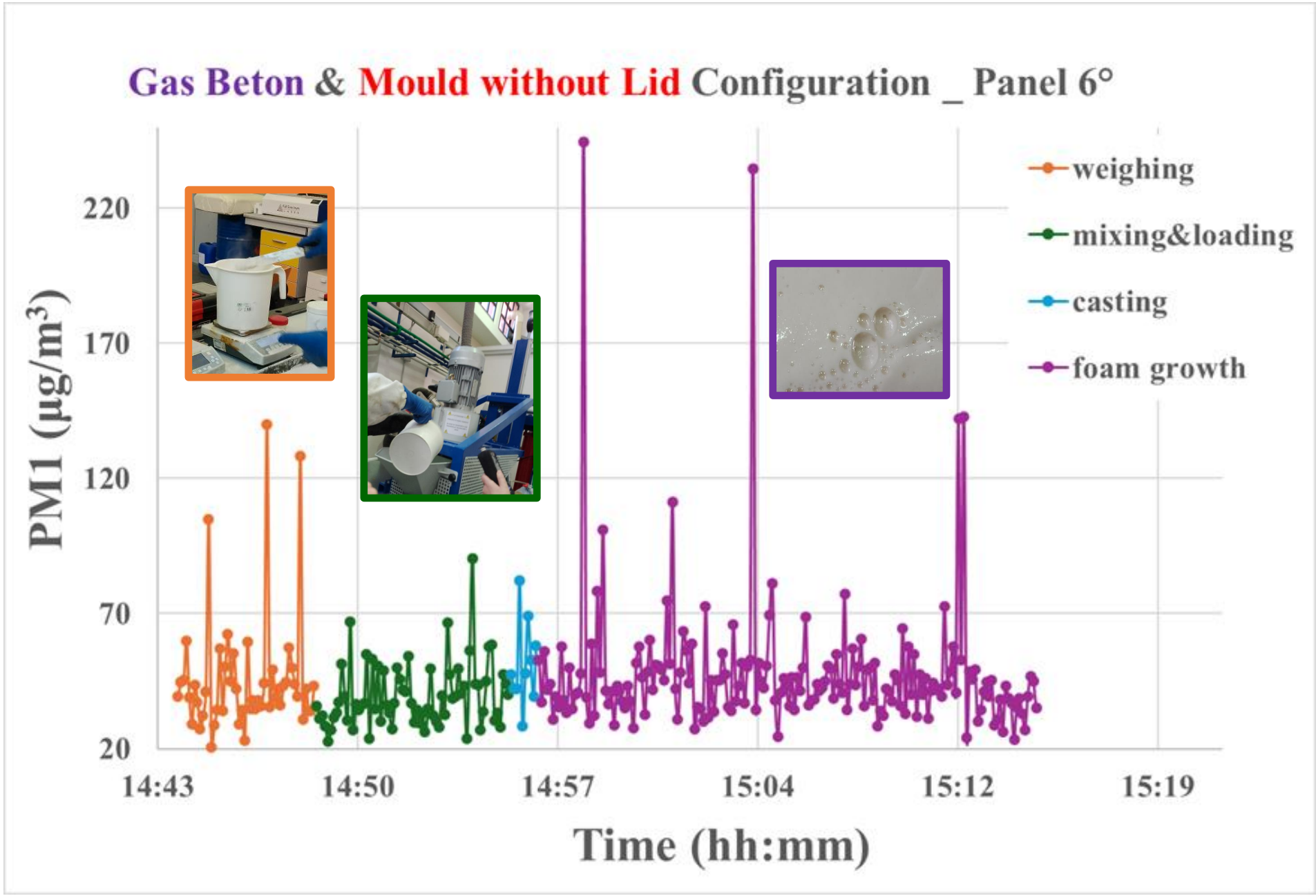
- Figure shows all the steps required to create a panel, as seen in the Near Field, for PM1 data.
- Panel made on 17th afternoon. Formulation with Gas Beton and **Open Mold Configuration**.
- Several quick spikes detectable also in the Far Field.



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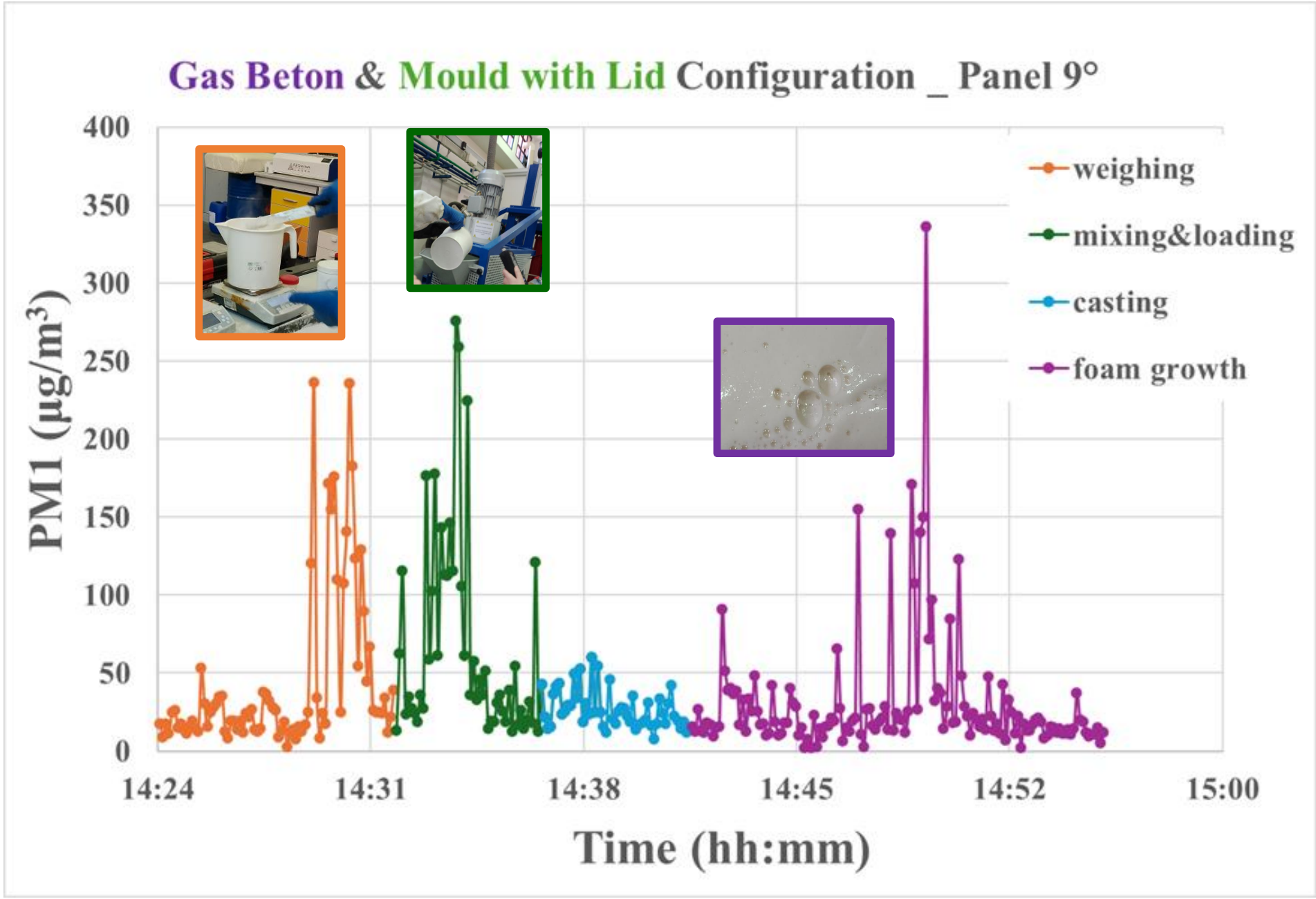
- Figure shows all the steps required to create a panel, as seen in the Near Field, for PM1 data.
- Panel made on 18th afternoon. Formulation with Gas Beton & **Closed Mold Configuration**.



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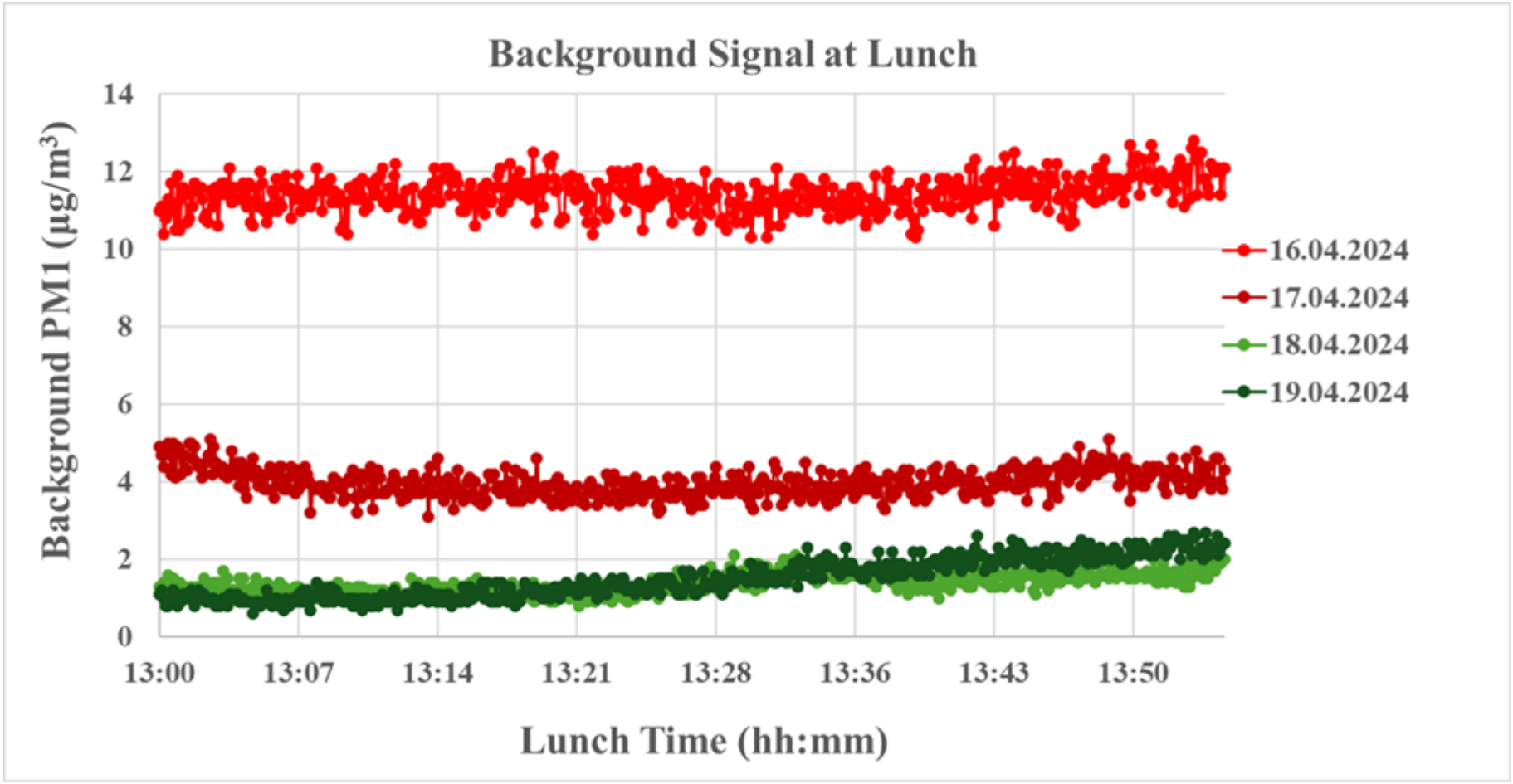
Focus on the «Foam Growth», just after the casting, for the two panels having the same formulation (with Gas Beton), made at the end of the day.

Figure shows PM1 data in the Near Field after the casting, when no other operation are performed and **the only difference is the Mould With/Without Lid configuration**.

Average PM1 is lower for the «Mould With Lid» configuration (green is under the red signal). But background is not substracted yet.

- As expected, there are no spikes in the absence of operations, during breaks.
- However, background levels can vary slightly from day to day.
- On April 16th (*mould without lid* setup day) background levels are higher.
- On April 18th and 19th (*mould with lid* setup day) the background levels are lower, since it was rainy.



Field Campaign II) : the Cutting Phase

Note:

- The cutting phase is carried out in a separate room with a band saw.
- The panels cannot be cut immediately after casting, as some chemical reactions continue to occur inside them, even after a few hours. For this reason, the cutting was performed after the weekend.

Strategy:

- The 6 panels containing Gas Beton were cut in the morning of April the 22nd2024
- The 6 panels containing Diatomite were cut in the afternoon of April the 22nd2024

Cutting Machine

Field Campaign II) : the Cutting Phase

Near Field (NF) Instruments

- OPC 11-A, Grimm (CNR-ISAC)
- Nucleopore filter for SEM analyses (CNR-ISAC)
- Teflon filter for gravimetric analyses (CNR-ISAC)
- ELPI+, Dekati (UNIMIB)

Far Field (FF) Instruments

- OPC 11-D, Grimm (CNR-ISAC)
- Partector, Naneos (CNR & UNIMIB)
- Nanoscan SMPS, TSI (UNIMIB)
- Air Quality Monitor, PurpleAir (UNIMIB)

Personal exposure monitoring (worker)

- Diffusion Size Classifier DiSCmini, Testo (CNR-ISAC)
- Portable PM Sampler, SKC Leland Legacy (CNR-ISAC)

Near Field (NF)

Far Field (FF)

Work planned for the NEXT 6 MONTHS

Data Collection and Preparation

- Gather data from all the instruments and **ensure common unit and formats**.
- Clean and preprocess the data. **Eliminate** any outliers or **erroneous data** points .
- **Create a structured database or spreadsheet to facilitate analysis**.

Background Estimation and Selection of the Processes of Interest

- **Determine background** concentrations during non-emission periods.
- **Select** processes for detailed analysis **and subtract background**.
- **Integrate results from near field vs. far field** comparisons and background estimates.

Analysis and Influence of KDF Parameters

- Compare averages for each process and identify patterns or correlations.
- **Assess variability within and between the processes** and identify any outliers.
- **Assess the influence of KDF** on measured mass and concentration data.

Any Questions?