Analysis of Compressed Medical Air

by

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Introduction

- Medical air produced on site
- Medical air is used for patients-neonates, patients suffering from respiratory disease
- Medical air is governed by NFPA under USP
- No specification on microbial contamination limits

Materials and Methods

- Medical air samples were taken at 5 hospitals and at dental school
- SMA sampler and Modified Andersen sampler used for analysis of microbial contamination in medical air
- Both samplers were operated for 3 minutes and 1 minute @ 1CFM
- In hospital-1 the medical air was also sampled for 35 minutes using both samplers @ 1CFM

Modified Andersen sampler & SMA sampler operating in hospital-1

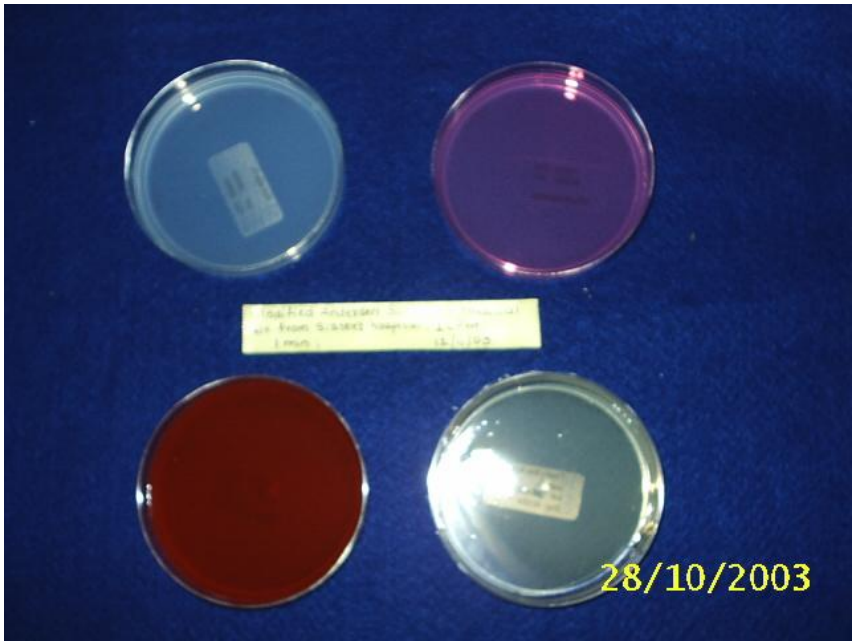
Modified Andersen sampler

Materials and Methods (contd.)

- Four media-BA, R2A, TSA, RBA were used to detect human associated, environmental associated, thermophilic bacteria and fungi, respectively
- BA was kept at 35^{o}C for 4 days
- R2A was kept at 23+/-3^{o}C for 4 days
- RBA was kept at 23+/-3^{o}C for 7 days
- TSA was kept at 56^{o}C for 4 days

Check for Microbial growth on the four media

SMA sampler



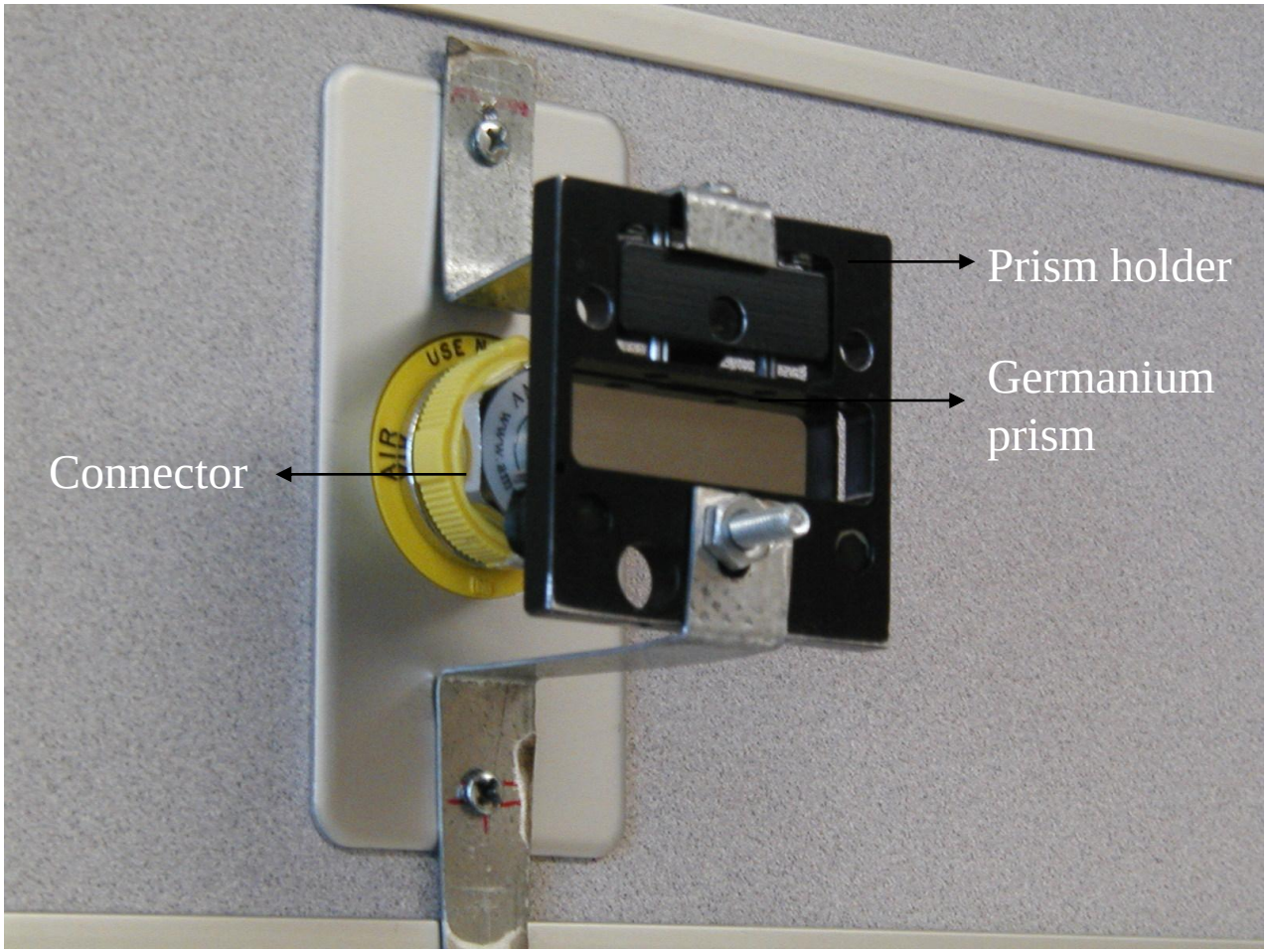
Modified
Andersen sampler

Air impactor

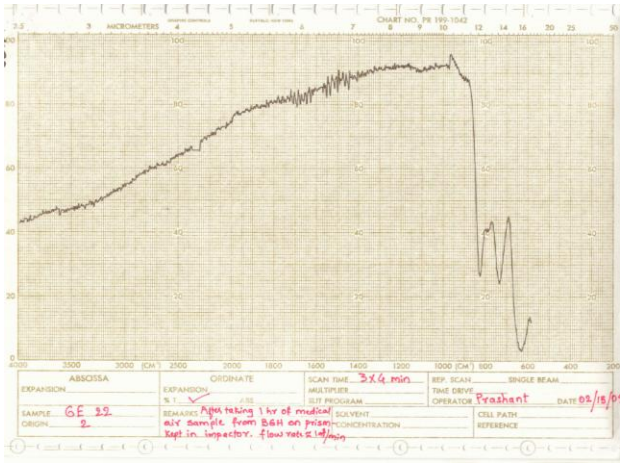
Materials and Methods (contd.)

- Germanium prism placed in Air impactor
- Medical air was bombarded on germanium prism kept in the Air impactor for 1 hour
- Germanium prism held in front of connector by attachments
- Medical air deposits on prism were analyzed for organic matter and particulate debris by Infrared spectroscopy, SEM and EDX

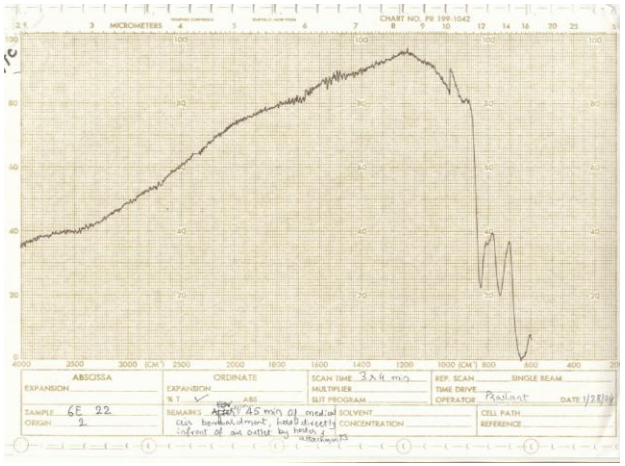
Prism kept in the prism holder held in front of connector



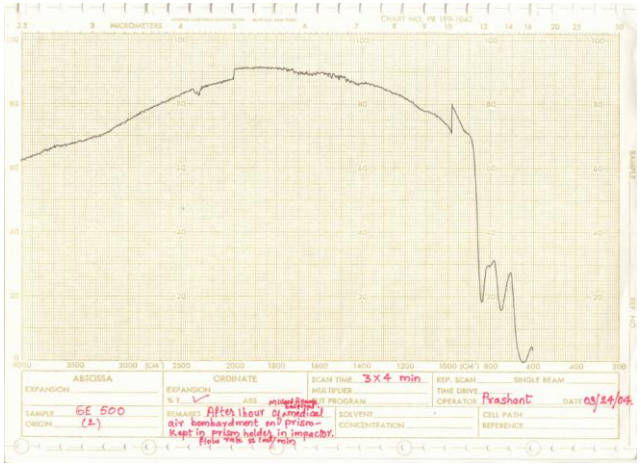
Typical IR spectra-medical air



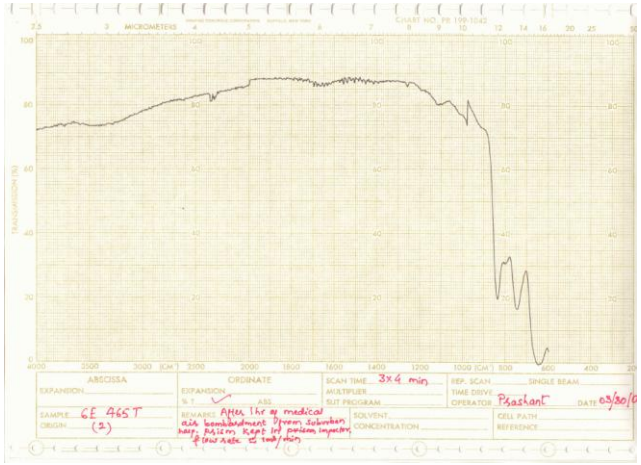
Hospital-1



Hospital-2



Hospital-3

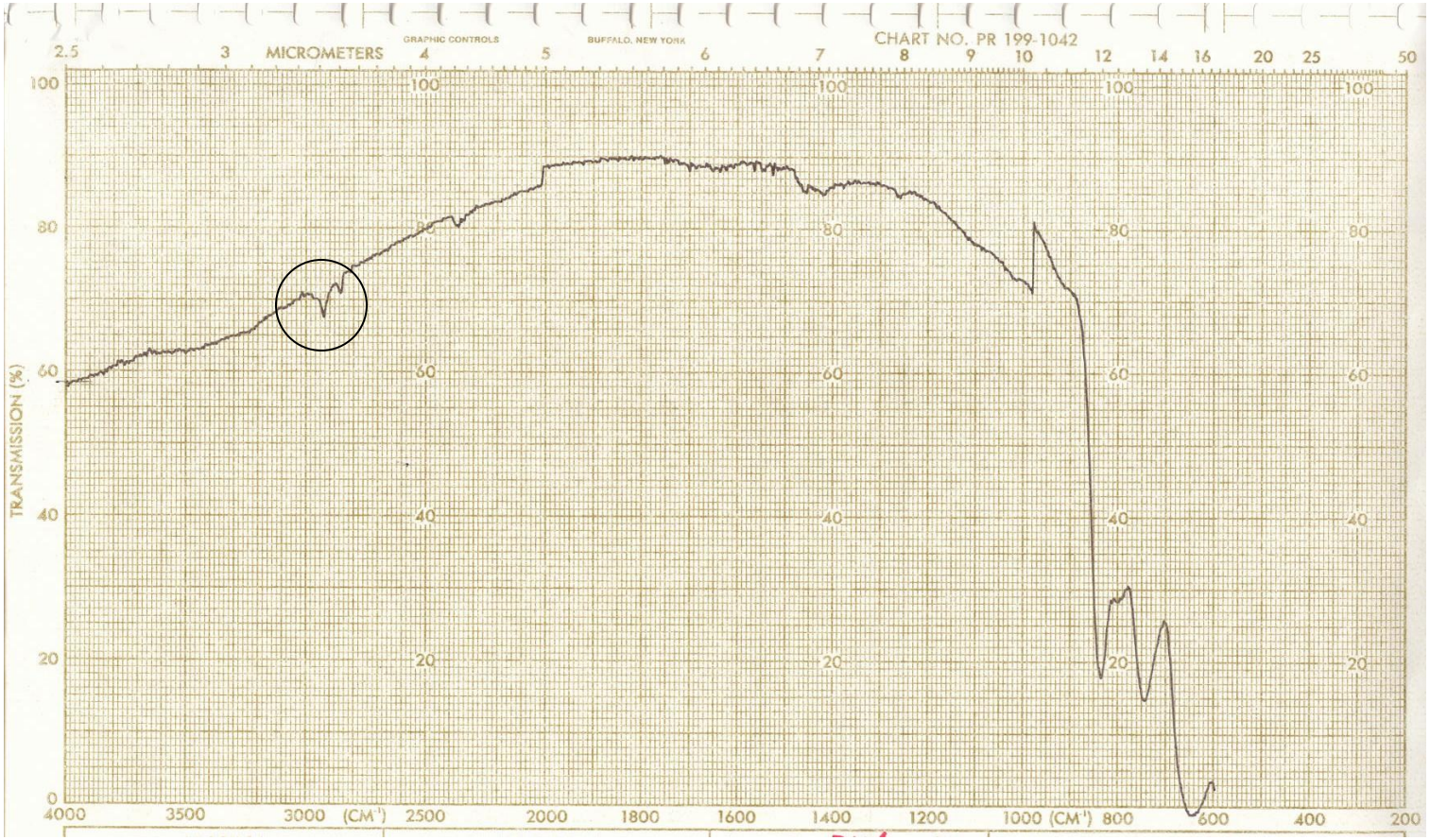


Hospital-4

Results

- Twenty four (24) media of each type were used for medical air sampling at each hospital
- No microorganisms were detected on the media from 5 hospitals
- From the IR spectroscopy analysis no chemical bands were detected except for hydrocarbons in hospital-5

IR spectrum-medical air



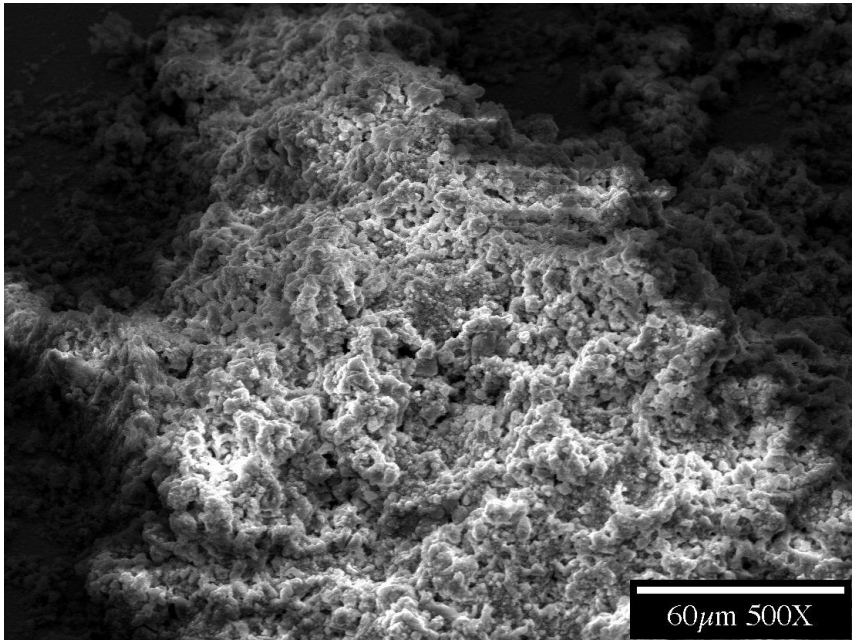
Hospital-5

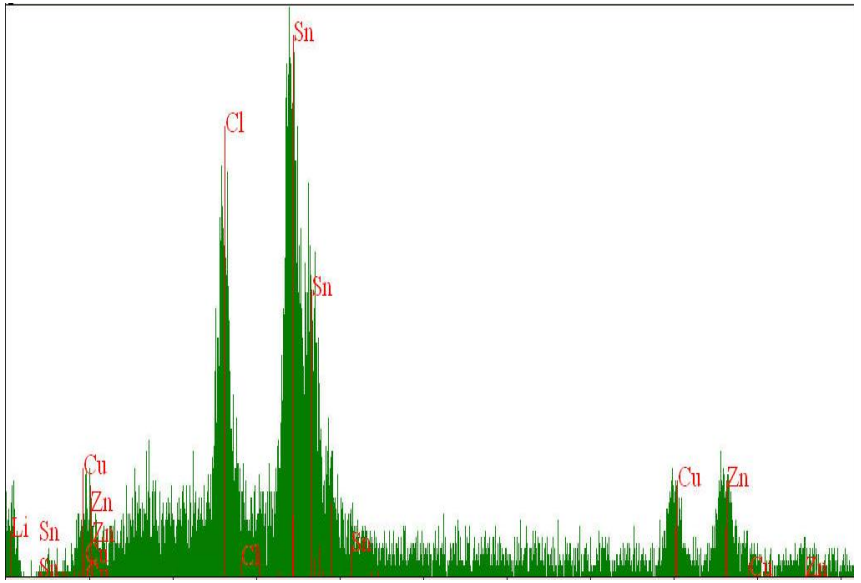
Results (contd.)

- SEM showed particles were in size range 0.1 micrometer to 100 micrometer

- EDX analysis showed particles contained these elements: Cu, Sn, Ca, Cl, K, Fe, Li, Zn, Al, Mg, Br, Si

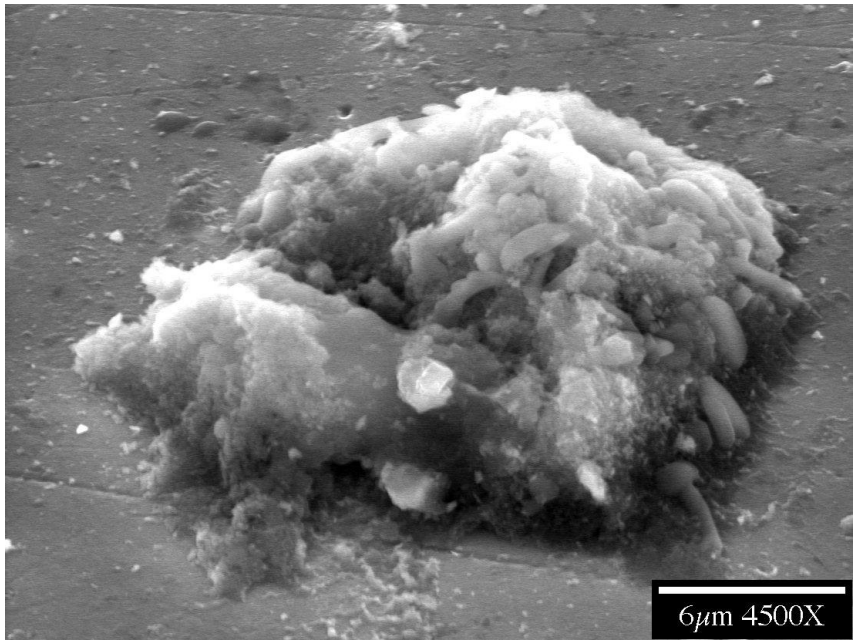
SEM and EDX of particle agglomerate on prism

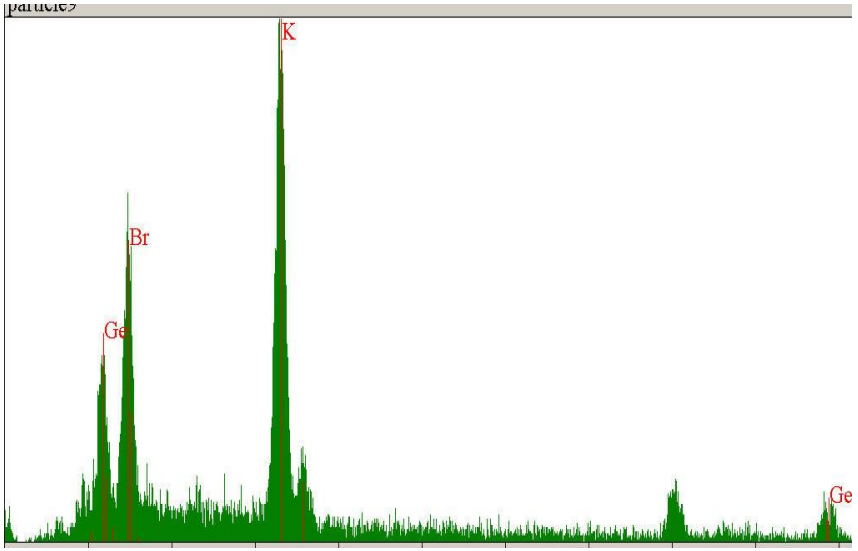




Sn, Cu, Zn, Li elements detected from the agglomerate of particles by EDX shown in the figure

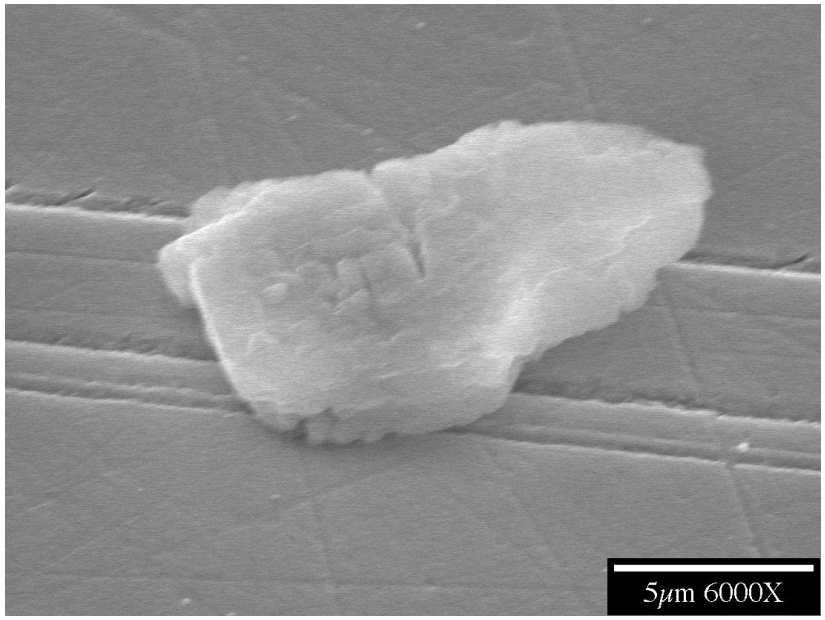
SEM and EDX of the particle from the medical air bombarded on prism

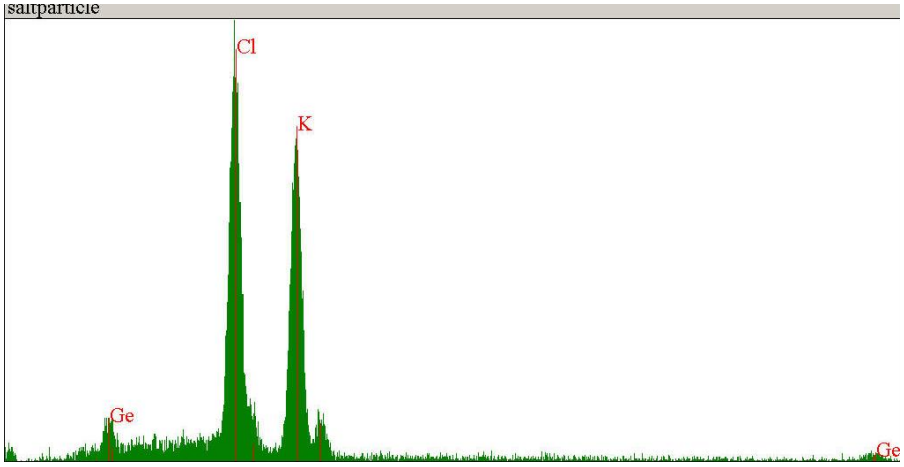




KBr detected by the EDX shown in the figure.

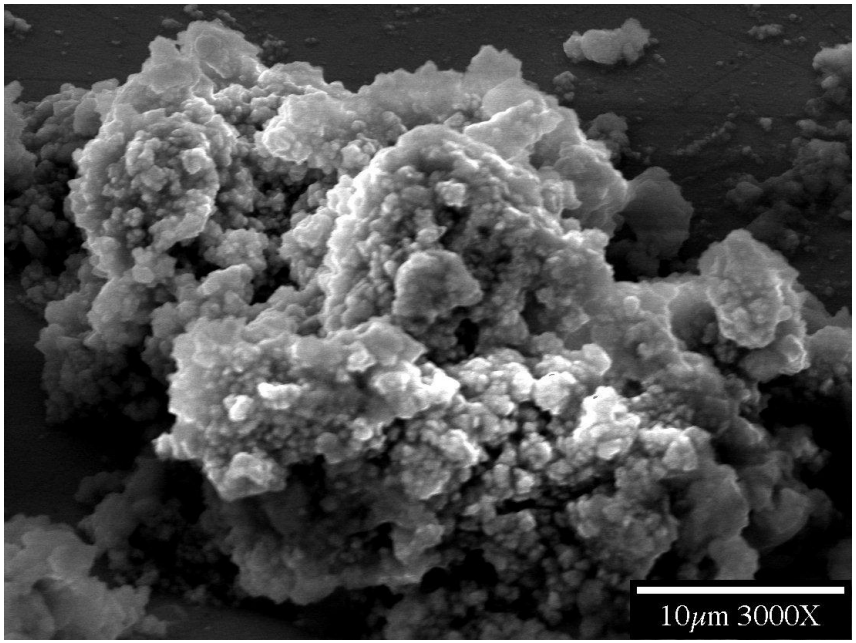
SEM and EDX of the particle from the medical air bombarded on prism

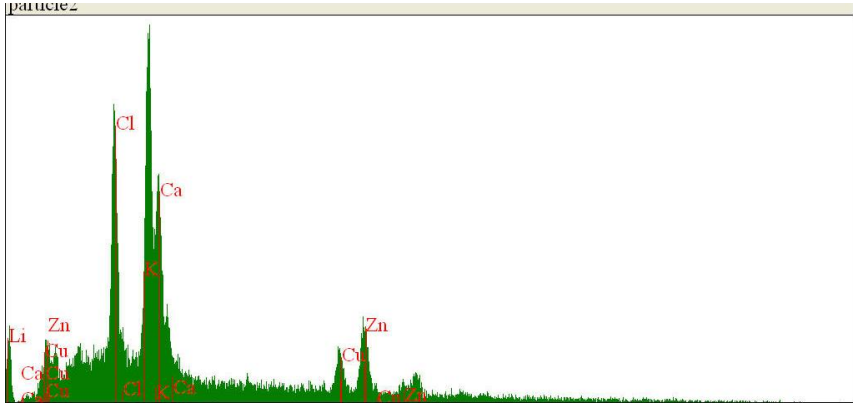




KCl salt particle detected by EDX

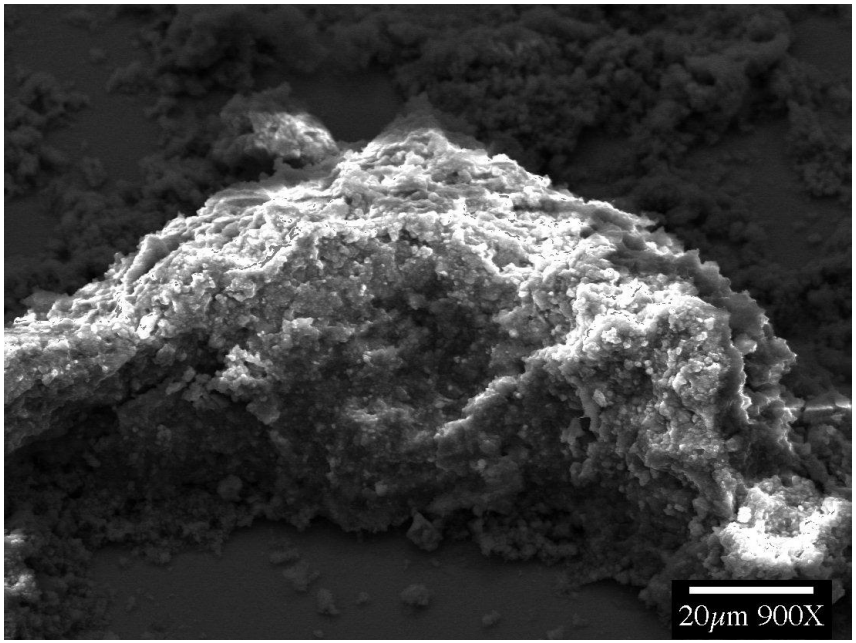
SEM and EDX of the particle from the medical air bombarded on prism

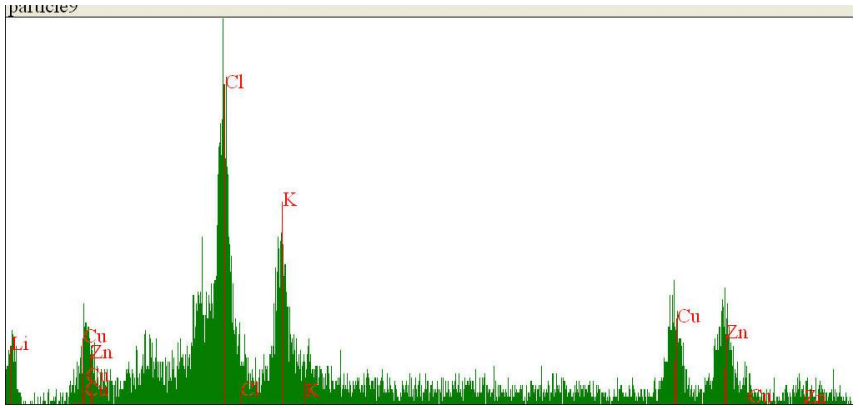




Li, Zn, Cu, Ca, Sn, Cl elements are detected by EDX

SEM and EDX of the particle from the medical air bombarded on prism



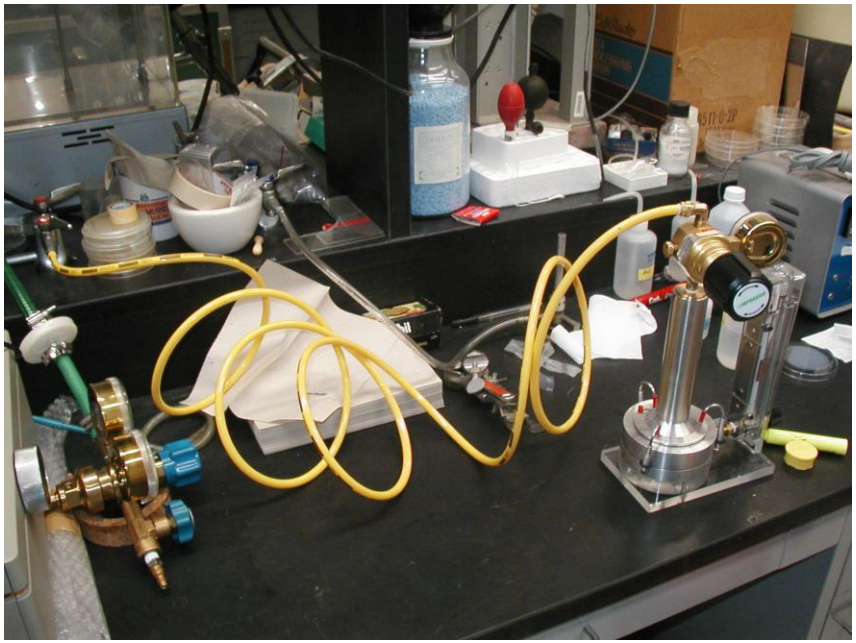


Size of the particle is approximately 100 micrometers

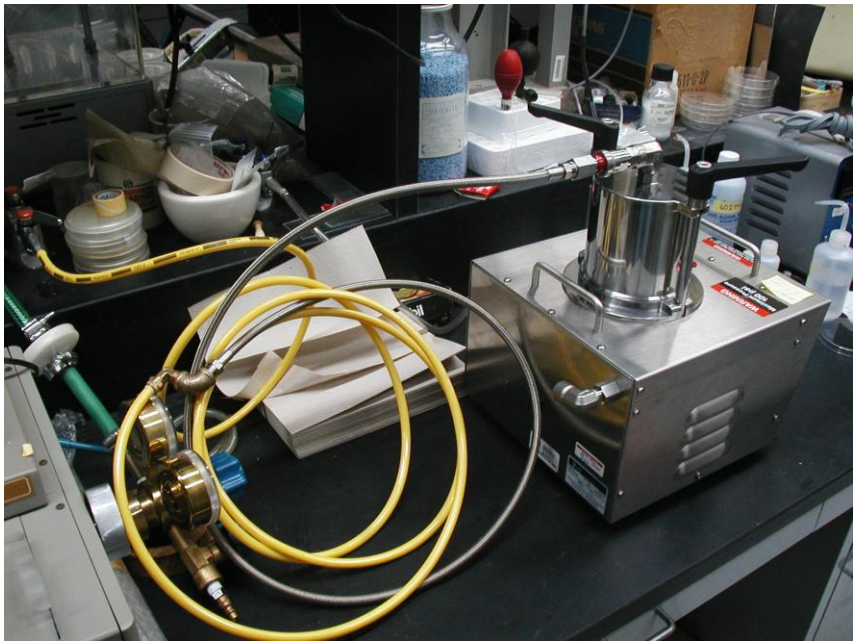
Analysis of Compressed air from the dental school

- Centralized compressor supplies the compressed air for the labs and dental clinic
- Compressor is oil-free and refrigerant based drying
- SMA, Modified Andersen sampler used for analysis of air for detection of microorganisms
- Both samplers were operated for 35 minutes @ 1CFM

Analysis of Compressed air from the dental school (contd.)

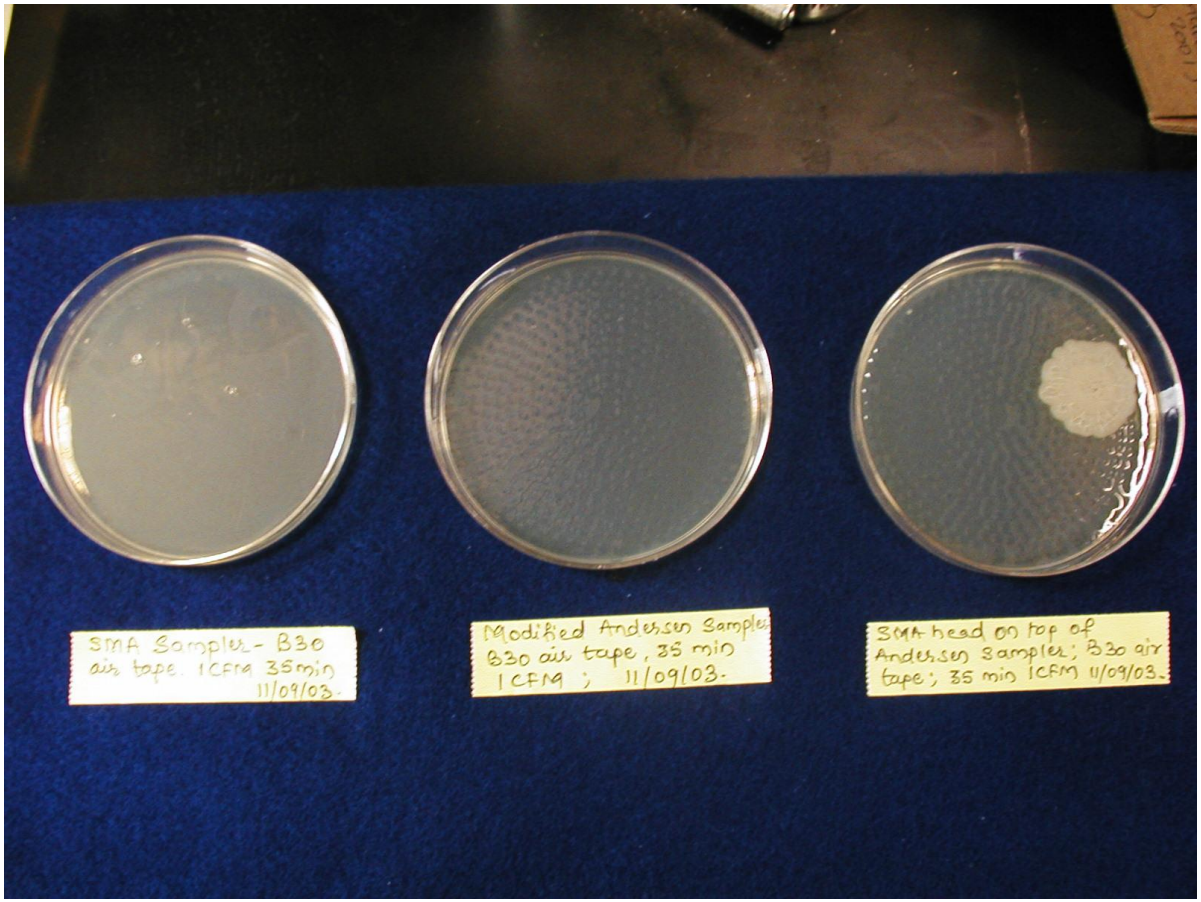


Modified Andersen sampler operating in the lab



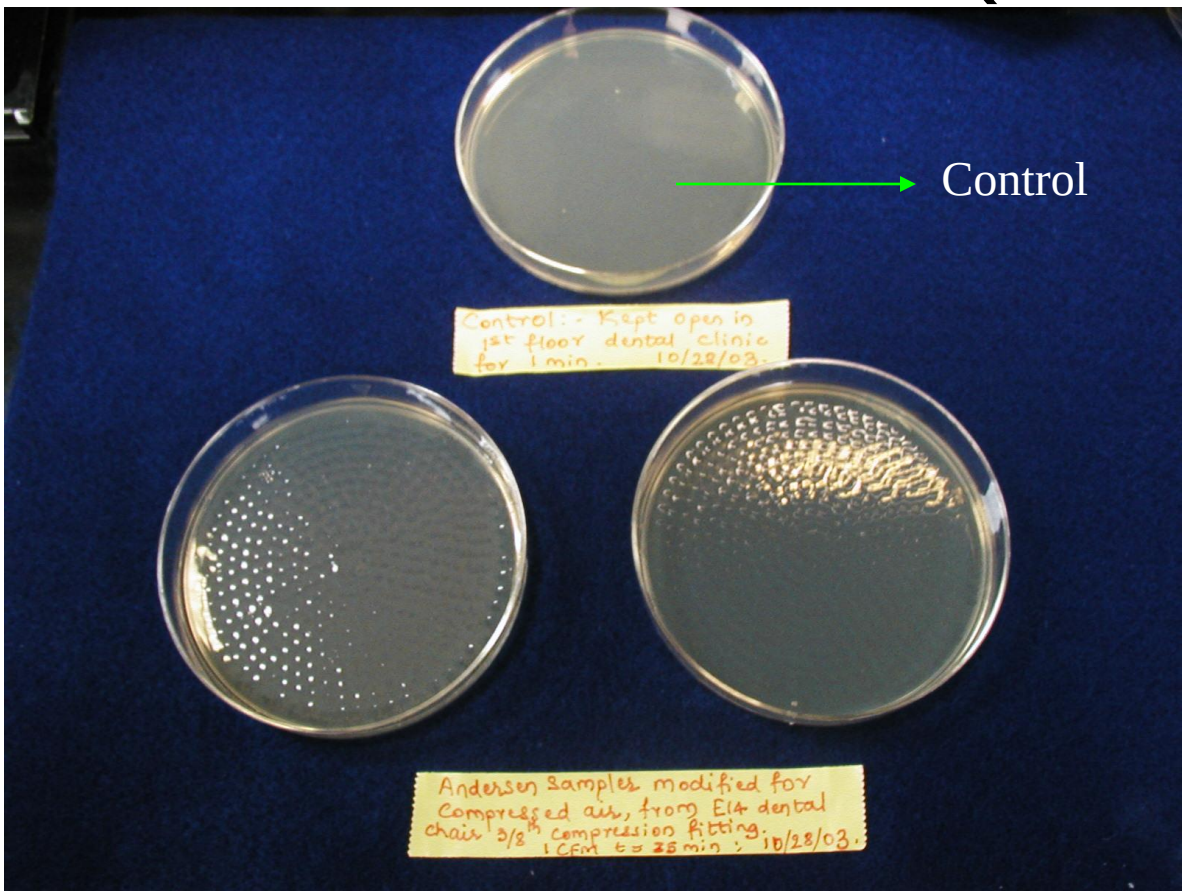
SMA sampler operating in the lab

Analysis of Compressed air from the dental school (contd.)



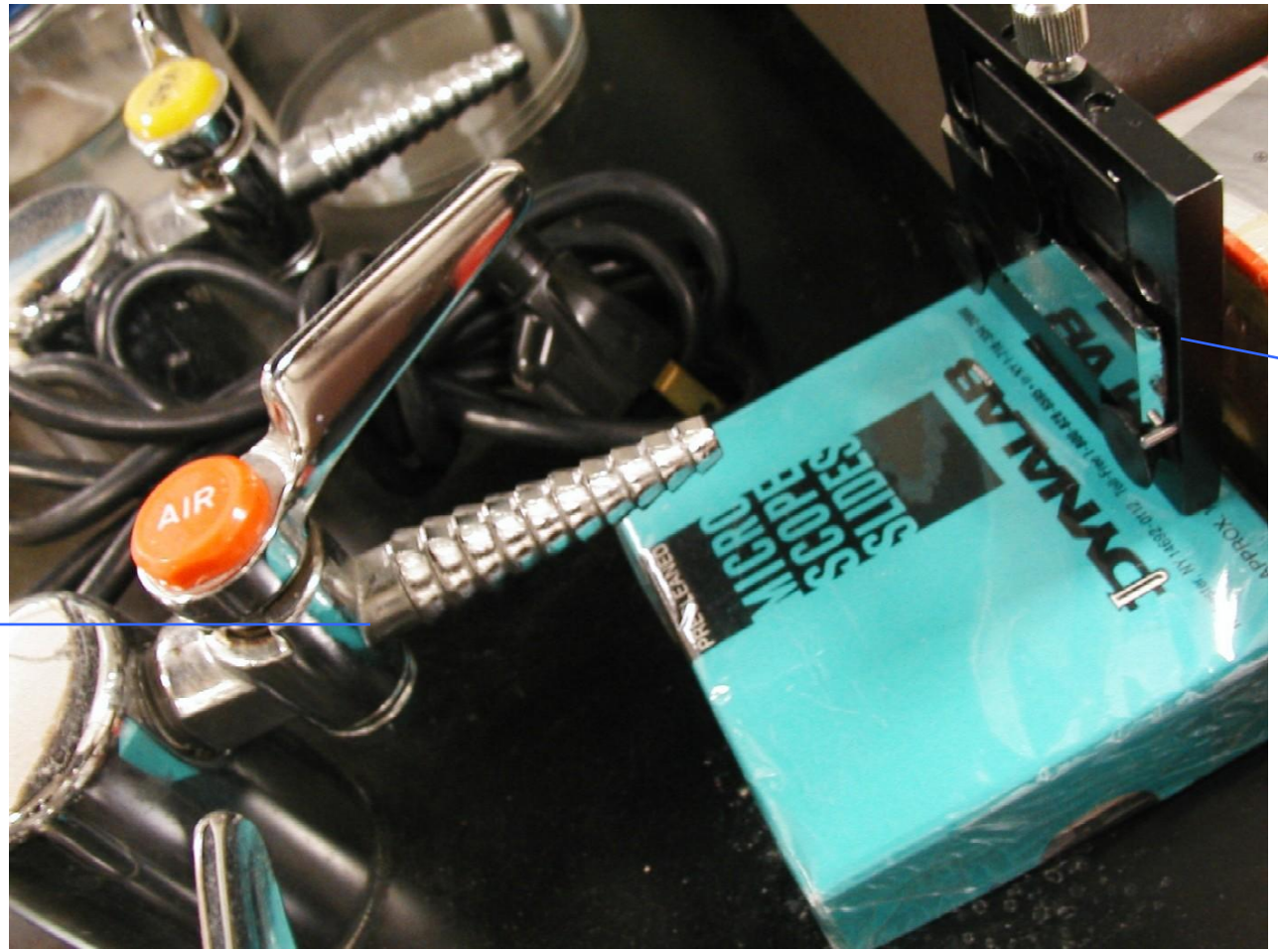
Compressed air samples from air tap using SMA, Modified Andersen sampler, SMA on top of Andersen sampler, 1CFM, 35 min

Analysis of Compressed air from the dental school (contd.)



Compressed air samples from dental chair using Modified Andersen sampler, 1CFM, 35 min

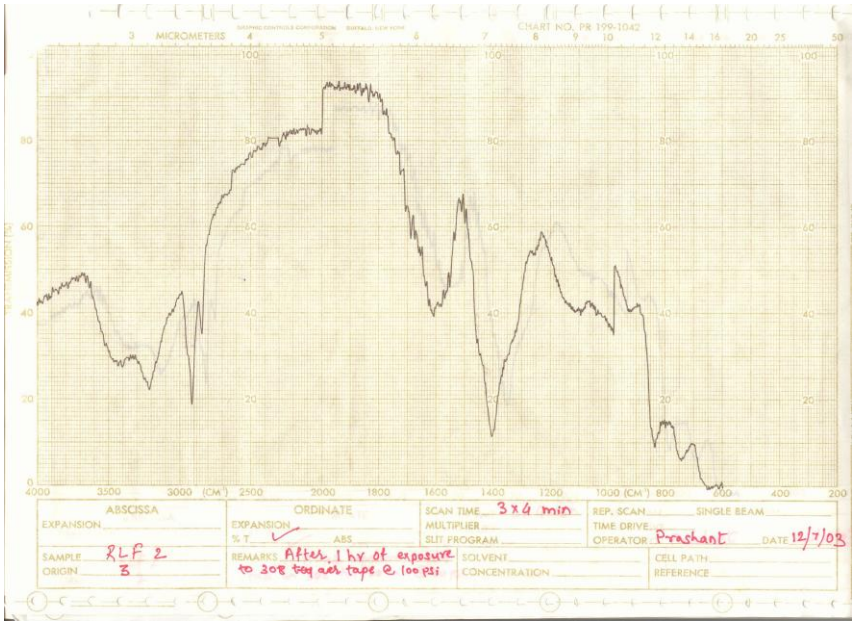
Analysis of Compressed air from the dental school (contd.)



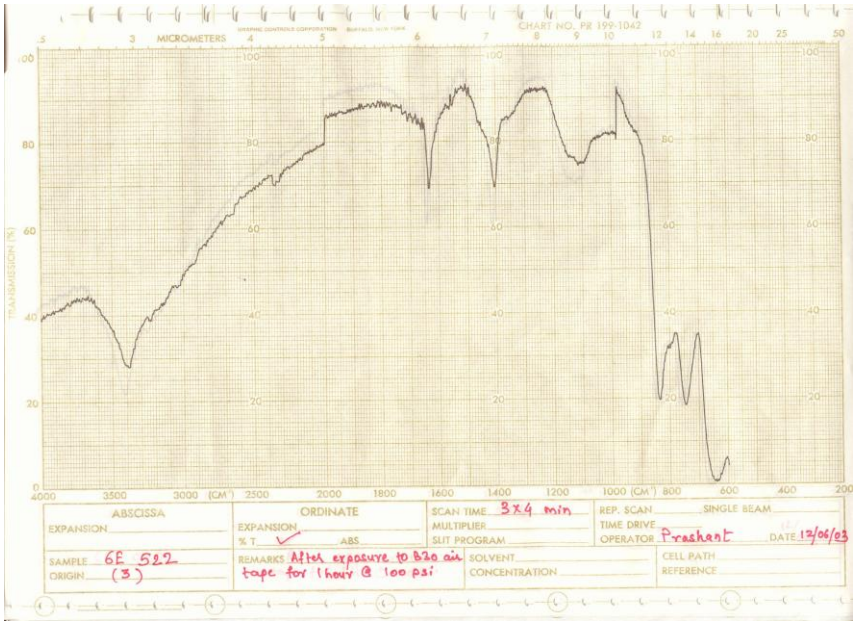
Analysis of Compressed air from the dental school (contd.)

- Germanium prism placed in the prism holder was kept in front of the air tap
- The compressed air was bombarded on the prism for 1 hour
- Compressed air deposits on prism were analysed for organic matter and particulate debris by Infrared spectroscopy, SEM and EDX

Analysis of Compressed air from the dental school (contd.)

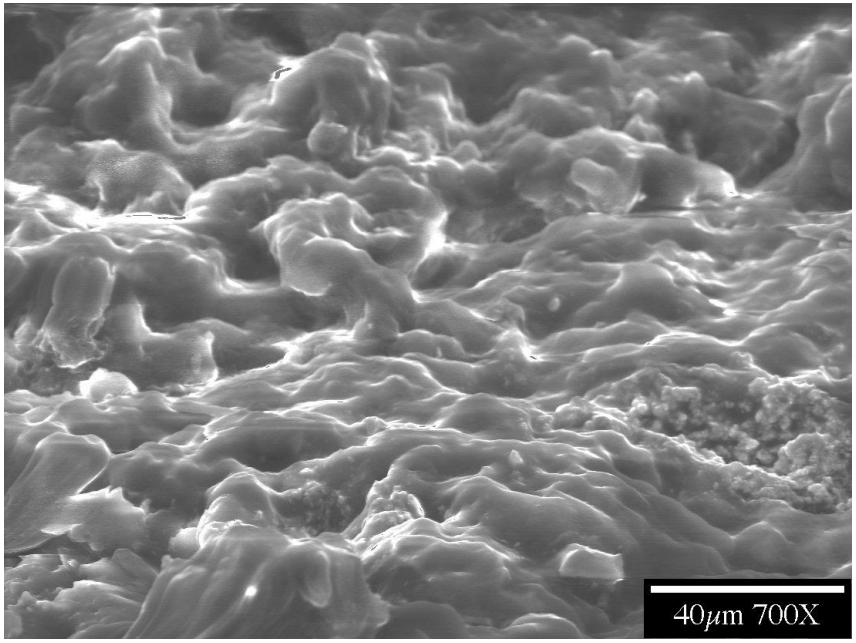


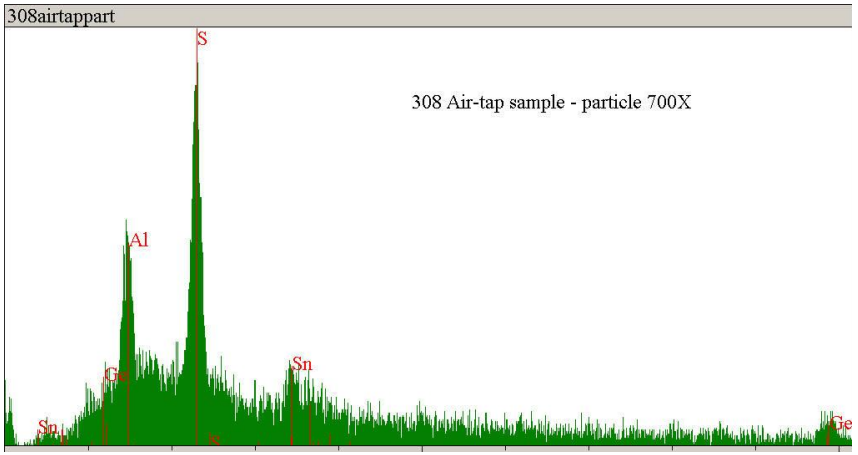
IR spectrum from the compressed air deposits-lab 308



IR spectrum from the compressed air deposits-lab B30

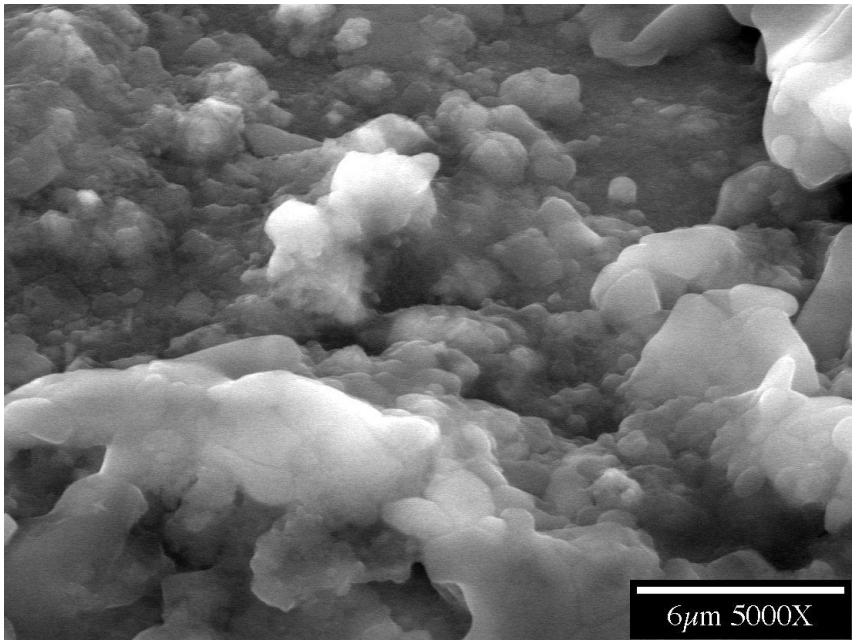
Analysis of Compressed air from the dental school (contd.)

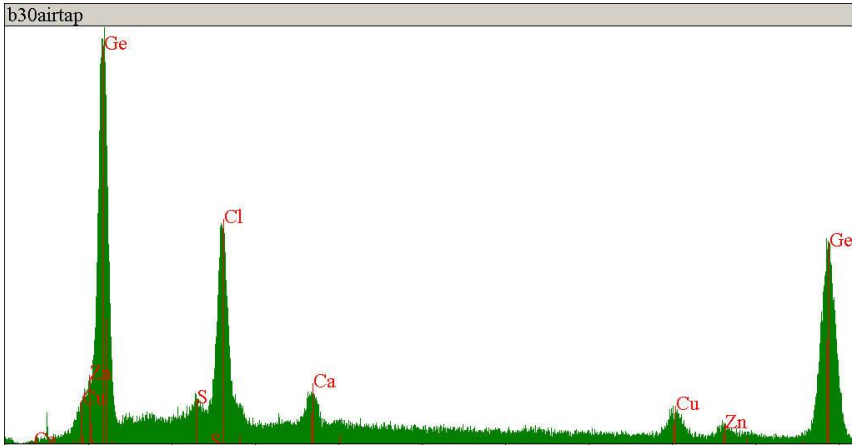




Elements-Al, Sn, S detected by EDX

Analysis of Compressed air from the dental school (contd.)





Elements- Cu, Zn, Cl, S detected by EDX

Discussion

- Dr. Bjerring and Dr. Oberg had detected bacterial contamination in medical air in one hospital of Denmark
- No detectable microorganisms in medical air, confirming effectiveness of use of oil-free compressors and refrigerant based drying
- Collected previously uncharacterized metallic and flux particles from medical air systems at all five test sites

Discussion (contd.)

- Particles detected could derive from fluxes during the welding operations of piping joints
- The efficiencies of the two sampler could not be compared because no microorganisms detected in medical air in any case

Future work

- Cross check Modified Andersen and SMA sampler in controlled air volumes seeded with known microorganisms
- Detection of Legionella bacteria in medical facilities
- Concentration of particles in the medical air
- Detection of SO_2, NO and NO_2 during peak hours of traffic

Acknowledgement

I sincerely thank

- Praxair Inc.
- Dr. Robert E. Baier
- Plant operation managers of the Hospitals