

WORKSHOP SESSION SUMMARY
POST-CONFERENCE PROCEEDINGS
2018 National Trainers' Exchange

1. Session Title and Presenter's Contact Information:

Workshop title: #14 Visualization Technologies in the Classroom

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Presenter Organization: IUOE National Training Fund

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2. Workshop Summary:

Enhancing the training skills of Peer Trainers is a key emphasis of the IUOE National Training Fund in delivering safety and health training to its members. The NTF develops tools to train its Peer Trainers, to more effectively accomplish the training and to improve their ability to present difficult to understand concepts. Many of the worker training courses (including HAZWOPER, respiratory protection, refreshers, industrial hygiene, and confined space) have a commonality of concepts that can be better conveyed through visualization. These are concepts such as ventilation, opacity, hazardous gases and vapor concentrations (PELs, RELs), and measurement techniques and calibration. A quarter meter (1/4 meter cubed) visualization chamber constructed of plywood with Plexiglas faces in a precise cube is such a tool. Each face has access ports strategically placed and easily adapted to particle generation, opacity meters (laser systems) and monitoring instrumentation. Participants should gain a working knowledge of how to interpret this practical information in real time and solve problems in the classroom.

3. Methods:

Ventilation is one of the most commonly used and effective engineering methods for contaminant control utilized in the workplace. When properly designed and used, ventilation can minimize exposure of hazardous vapor phase or particulate matter to acceptable levels or eliminate them completely. Confined spaces are workplaces that ventilation is integral to working in that environment. How effective it is depends upon the area configuration, size, barriers and other obstructions, and can influence the techniques used in the measurement of the contaminant levels.

The NTF develops tools for the instructors to use to more effectively accomplish the training and improve their ability to present difficult-to-understand concepts. Many of the worker training courses (including HAZWOPER, Respiratory Protection, Industrial Hygiene, and Confined Space) have a commonality of concepts that can be better conveyed through visualization. These are concepts such as ventilation, opacity, hazardous gases and vapor concentrations (PELs, RELs), and calibration of instrumentation used for measurement techniques. A one-quarter (1/4) m³ visualization chamber constructed of plywood with Plexiglas faces in a precise cube is such a tool to assist in the demonstration of these concepts.

The basic concept of flow can be expressed by the formula $Q = VA$, where:

- Q = air flow rate in cubic feet per minute
- V = air velocity in feet per minute
- A = hood or opening area in square feet

Using an oil droplet generating system, the cube volume is saturated until the total volume of the space loses its transparency. Using different volumetric flows selected from the following table the length of time needed to dispel the droplets from the cube and transparency returns is recorded. During each set of conditions, the flow patterns are observed using light scattering with incandescent light and qualitatively visualizing air flow.

Air Velocity (V , ft ² /min)	Pipe Area (A , ft ²)	Volumetric Flow (Q , ft ³ /min)
100	.006	0.6
200	.006	1.2
300	.006	1.8
400	.006	2.4
500	.006	3.0
600	.006	3.6
700	.006	4.2
800	.006	4.8
900	.006	5.4
1000	.006	6.0

The following photograph shows the preparation of the unit for the evaluation of various measurement techniques. In addition to the visualization of ventilation patterns, introduction of contaminant species using controlled safety measures can be used to evaluate colorimetric tube, and other real time reading instrumentation such as the four-gas monitor. This unit realistically approaches the use of monitoring units a worker would experience in the field.

Flow Visualization Chamber being prepared for demonstration



4. Main Points/ Key Points Raised from Participants:

Several participants asked how extensively the technique of the visualization box can be applied: can it be used to do particle measurements, can we do visualization experiments showing how ventilation removes contaminants from the box, and can we test gas sampling systems such as colorimetric tubes and handheld four-gas monitors? The NTF is continuing to develop generating solid particles (instead of oil droplets). This will enable the system to better evaluate in-situ particle monitors and opacity meters. One student recommended using a medical aspiration technique to generate the particles because this may solve the problem of low concentrations of particles that are needed to conduct the experiment.

Once the NTF perfects the visualization technique it will improve the qualitative information of the flowrate and flow patterns and give a picture of how the ventilation flow is interacting with the walls of the chamber. The takeaway is that the students can use this information to help analyze ventilation being used to remove contaminants from a room or ventilating a confined space.

5. References:

NTF OSHA 521 IH Lab Supplement (M-069-2017.SP).

6. Workshop Handouts/ Resources:

PowerPoint.