

SELECTION PROCESS

**Air Purifying Respirator
(APR) versus Self
Contained Breathing
Apparatus (SCBA)**

Robert Evangelista

RESPIRATORY APPARATUS

Defines Respirator Type

- **Device for air supply or purification**
 - » **air-purifying respirator**
 - » **atmosphere-supplying respirator**
- **Facepiece seals out contaminants**
 - » **half & quarter face**
 - » **full face**
 - » **hood**

RESPIRATOR TYPE

- **Air-purifying respirator (APR) - air purifying element**
 - » mechanical filter
 - » chemical adsorbent cartridge
- **Atmosphere-supplying respirator (ASR) - clean breathing air source**
 - » airline respirator - air via hose
 - » self-contained breathing apparatus (SCBA) - air from a portable container

APR & ASR MODES OF OPERATION

- **Negative pressure inside facepiece**
 - » leakage in
 - » APR - wearer breathes in
 - » ASR - air on demand type
- **Positive pressure inside facepiece**
 - » leakage out
 - » APR - pump driven
 - » ASR - pressure-demand type
 - continuous flow type

APR LIMITATIONS

- Hazard must be known
- Maximum Use Concentration (MUC)
 - » ambient concentration
 - » exposure limit
- Hazard Ratio (HR)
- Oxygen must be >19.5%
- Air sample(s) must be taken

EXPOSURE LIMITS (EL)

- **Permissible exposure limit (PEL)**
- **Threshold limit value (TLV)**
- **Recommended exposure limit (REL)**
- **Workplace environment exposure limit (WEEL)**
- **Immediately dangerous to life or health (IDLH)**
- **Maximum permissible concentration (MPC)**

RESPIRATOR MAXIMUM USE CONCENTRATIONS (MUCs)

- Multiple of EL
- Use lowest EL: PEL, TLV, REL, WEEL
- No fit test, MUC = 5
- Escape auxiliary self-contained air
- Chemical specific standards?

MAXIMUM USE CONCENTRATION & HAZARD RATIO

$$\text{MUC} = \text{PF} \times \text{EL}$$

$$? = 10 \times 10 \text{ ppm}$$

$$500 \text{ ppm} = ? \times 5 \text{ ppm}$$

For particulates only:

$$\text{HR} = \text{HC} / \text{EL}$$

$$? = 20 \text{ ppm} / 2 \text{ ppm}$$

SELECTION CONSIDERATIONS

- **Classification of hazard**
- **Hazard assessment**
- **Warning properties**
- **IDLH**
- **Lower flammability limit**
- **Skin or eye problems**
- **Sorbent characteristics**
- **Physiological/psychological limitations**

CLASIFICACIONES OF RESPIRATORY HAZARDS

- Oxygen-deficient air
- Particulate
 - » fume
 - » dust
 - » mist
- Gas and vapor

HAZARD ASSESSMENT

- Requires knowledge of process or situation
- Air samples
 - » O₂ content (if necess.) &
 - » particulates and/or
 - » gases and vapors and/or
 - » radionuclides
- Sufficient sample frequency
- Determine hazard/O₂ conc.

WARNING PROPERTIES

- **Adequate warning properties:**
 - » odor, taste,
 - » eye irritation, and/or
 - » respiratory irritation

are detectable and persistent at or below the PEL
- **APRs prohibited for organic vapors with poor warning properties**

SKIN ABSORPTION & IRRITATION

- **Respirator - part of gear to protect skin**
- **Irritation - judgmental decision**
- **Absorption guideline - LD_{50}
= 2 g/kg**

SORBENTS

Can not use APR if:

- **Immediate breakthrough (< 3 min) at conc. < IDLH**
- **Inadequate sorption efficiency**
- **High heat of reaction**
- **Sorbed hazard is shock sensitive**

EYE IRRITATION

- Eye irritation unacceptable - use full face only
- Some irritation for escape
- Eye protection may be required for specific conc. of gases and vapors (30CFR11.90(b))

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (IDLH)

- **Purpose: exposure conc. to insure escape without injury or irreversible effects**
- **No APR use at conc. \geq IDLH**
- **Hazard has no IDLH,
500 X PEL = upper limit**

LOWER FLAMMABILITY LIMIT (LFL)

Conc. > LFL = IDLH

**Use pressure-demand (p-d)
SCBA or p-d airline with
auxiliary p-d SCBA**

PHYSIOLOGICAL AND PSYCHOLOGICAL LIMITATIONS FOR REPIRATOR WEARERS

- **Respiratory impairment**
- **Cardiovascular impairment**
- **Epilepsy**
- **Claustrophobia**
- **Facial hair**
- **Comfort & Vision**

NON-POWERED AIR PURIFYING PARTICULATE RESPIRATORS 42 CFR PART 84

- **9 new classes of filters**
- **3 categories of filter resistance**
 - » **N - oil-free solid/liquid hazard, no service time limit in most settings**
 - » **R - if liquid hazard contains oil, use for only one shift (8hr), or extend if eval, or < 200 mg mass loading**
 - » **P - any solid/liquid hazard, no service time limit in most settings**
- **3 filter efficiencies: 95, 99, 100%**

CHOOSE APR IF:

- Know the hazard
- Hazard > EL
- Hazard < IDLH
- Hazard < MUC
- Hazard < LFL
- Adequate warning properties

CHOOSE APR IF:

- **Appropriate HR (particulates)**
- **Oxygen > 19.5%**
- **Chemical specific standards?**
- **No sorbent problems**
- **Service limit (cart./can.) adequate**
- **Sufficient air samples**
- **No respiratory impairment**

Copyright © 1997 by Robert A. Evangelista. No part of this document may be reproduced, stored in a retrieval system, used in a presentation, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without prior written permission of the author.