

Metalworking Fluids as Complex Substances of Variable Composition



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Nature of Metalworking Fluids

- Complex
- Variable Composition
- Wide Range of Applications
- Wide Range of Conditions of Use
- Difficult to Characterize



What We Know

- Exposure to MRF Has Been Associated with a Variety of Health Effects
- It Is Not Clear that Gravimetric Measures of Particulate Exposure are Sufficient to Assess These Risks
- Dose Response Relationships Based on Gravimetric Measures Can Be Found Within Study Groups, but Do Not Appear in Comparisons Between Unrelated Groups.
- Controlling Bacterial Contamination of Fluid Has Been Shown As the Most Direct Path to Preventing and Eliminating Health Effects.

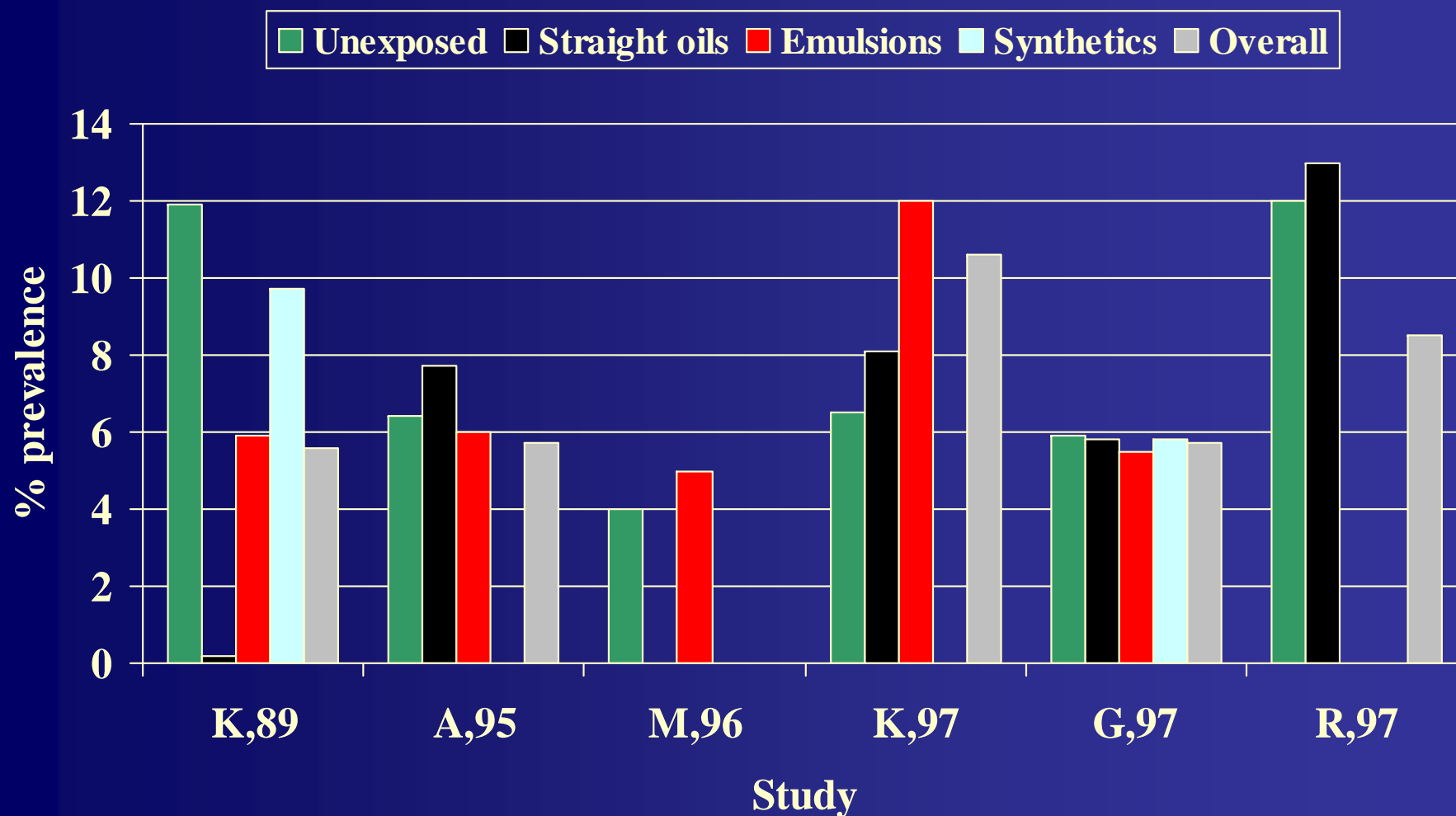


Health Effects

- Asthma
- Hypersensitivity Pneumonitis (HP)
- Chronic Cough
- Pulmonary Function
 - Cross-sectional studies
 - Cross-shift Change in FEV₁



Asthma Prevalence in MWF Studies*

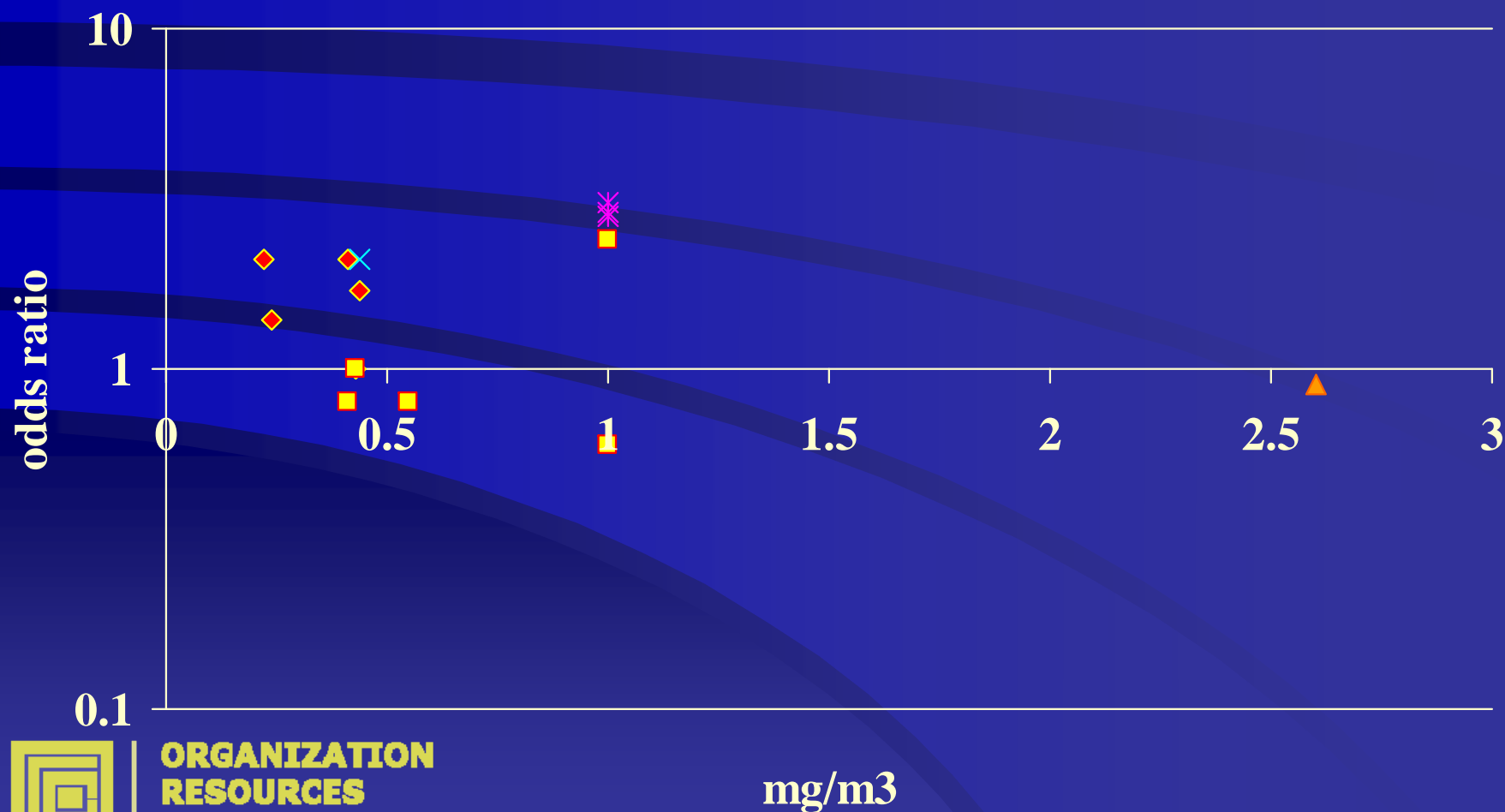


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*Courtesy of John Bukowski, ExxonMobil

Risk of Asthma Associated with MWF Aerosol Exposure

◆ Kriebel ■ Greaves ▲ Ameille × Robins * Rosenman



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mg/m³

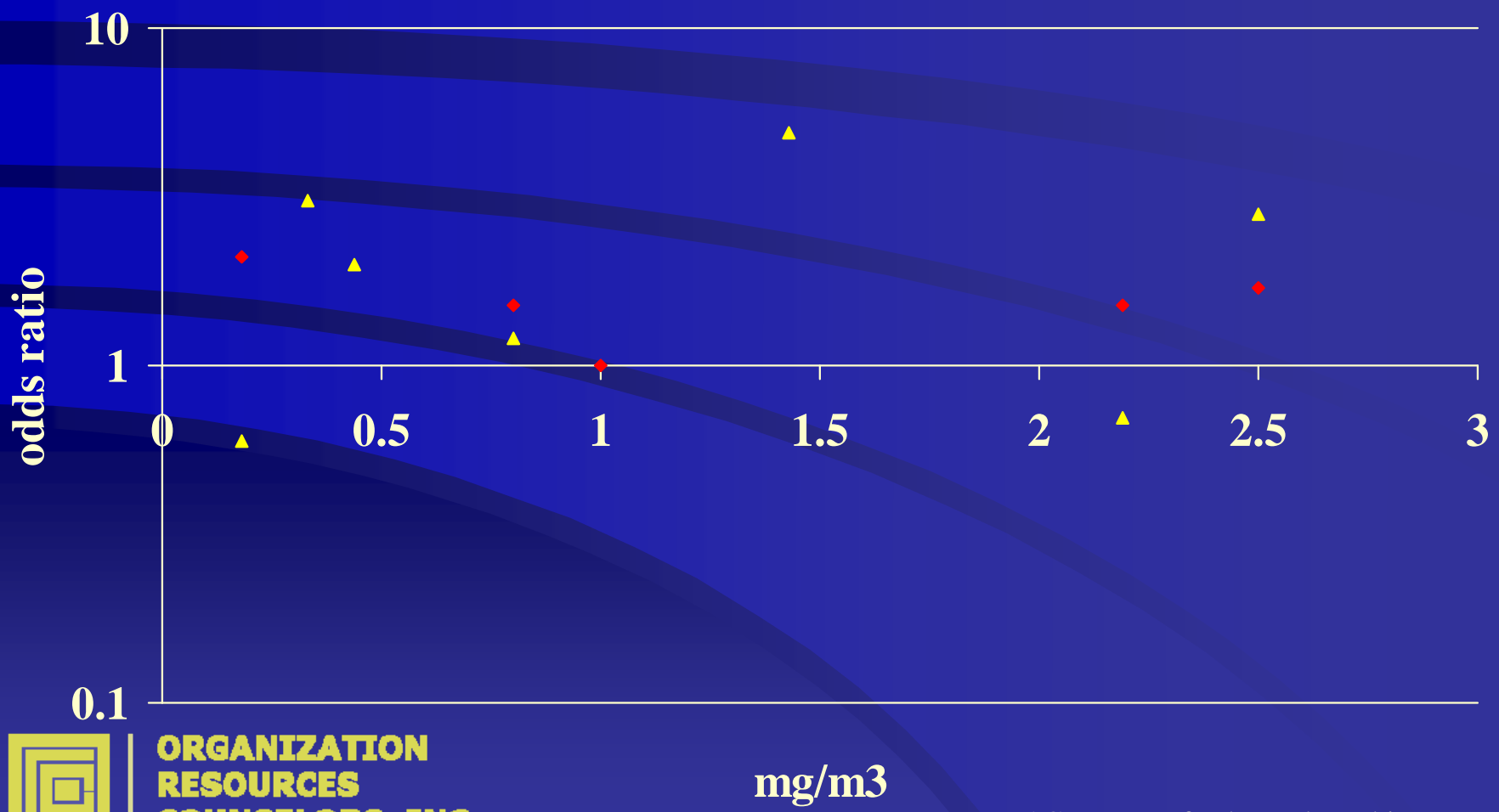
Hypersensitivity Pneumonitis (HP)

- Compelling Recent Studies Indicate HP May Be Associated with Mycobacterial Contamination of MWF.
- Majority of Reported Cases Have Occurred at Very Low MWF Aerosol Exposures



Association Between Chronic Cough and MWFs*

◆ Straight oil ▲ Emulsion



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mg/m³

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Pulmonary Function in MWF Studies*

- More objective measure than self-reported symptoms
- No evidence of permanent change
 - Baseline PF similar exposed vs. unexposed
 - No cross-week changes
- Possible acute cross-shift effects
 - Evidence not wholly consistent
- Most-likely cause is microbiological contamination of water-based MWF



What We Don't Know

- Specific Association Between Health Effects and Potential MRF Contaminants or Additives
- Dose Response Effect of Volatile MWF Components
- Full Characterization of Work Environments in Which Health Effects Studies Were Conducted



What This Implies

- A Simple TLV Will Not Protect Worker Health
- Recommendations Must Address the Root Causes of Health Effects
- We Must Work to Develop Simple Yet Effective Guidelines that Industrial Hygienists Can Implement



ACGIH Substances of Variable Composition (Appendix B)

B 1. Polytetrafluoroethylene
Decomposition Products

B 2. Welding Fumes--Total Particulate
(not otherwise specified): TLV-
TWA, 5 mg/m³.



MWFs As Substances of Variable Composition

B 3. Metalworking Fluids--Total Particulate (not otherwise specified): TLV-TWA, 1 mg/m³.

Plus:

A description of the complex composition of MWFs and the need to evaluate a broad range of parameters related to fluid formulation, process conditions, applications, and potential contaminants including microbial agents.



Current ACGIH TLVs for Potential MWF Aerosol Components

Acetaldehyde	25 ppm (45mg/m ³) ceiling
Ammonia	25 ppm (17mg/m ³) TWA; 35 ppm (24 mg/m ³) STEL
Cadmium metal and compounds	0.01 mg/m ³ TWA (elemental) 0.002 mg/m ³ TWA (compounds)
Chromium II and III Metal Cr(VI)	0.5 mg/m ³ TWA (Cr II and III) 0.05 mg/m ³ TWA as soluble CrVI 0.01 mg/m ³ TWA as insoluble CrVI
Cobalt metal dust and fume	0.02 mg/m ³ TWA
Diethanolamine	0.46 ppm (2 mg/m ³) TWA
Formaldehyde	0.3 ppm (0.37 mg/m ³) ceiling



Current ACGIH TLVs for Potential MWF Aerosol Components

Monoethanolamine (MEA)	3 ppm (7.5 mg/m ³) TWA 6 ppm (15 mg/m ³) STEL
Nickel Metal and compounds	1 mg/m ³ TWA (metal and insoluble compounds); 0.1 mg/m ³ TWA (soluble compounds)
Sulfur monochloride	1 ppm (5.5 mg/m ³) ceiling
Triethanolamine (TEA)	5 mg/m ³ TWA



Suggested Procedure for I.H. Assessment of MWF Environments

1. Examine MSDSs; identify the individual components of fluids and the amounts in which they are present.
2. Determine operating conditions to identify potential hazards created during manufacturing.
3. Assess potential for microbial contamination.
4. Develop sampling strategy to quantify airborne levels of all agents that pose potential risk.
5. Conduct root cause analysis for actual or potential health effects.
6. Make recommendations for control methods based on results of root cause analysis and health evaluations.



Available Guidance

- ORC Guide to Managing the Metal Removal Fluid Environment
- NIOSH Criteria Document
- OSHA Guidance Document
- British HSE Metal Working Fluid Good Practice Manual

