

LUBRICANTS, MACHINING AND AIR EMISSIONS



Overview

- ▣ Types of lubricants / fluids
- ▣ Alternative lubricants / fluids and study results
- ▣ Identification of emissions points
- ▣ Authorization mechanisms for lubrication, machining fluids and machining
- ▣ Quantification of emissions from lubricants and machining fluids
- ▣ Quantification of particulate matter from machining

Concerns

- ▣ Air pollutants & VOCs Create SMOG
- ▣ VOCs + NO_x + Sunlight = Smog + Ozone
- ▣ Machining & Cutting creates air pollution

Stacks and Smog



INDUSTRIAL SMOG BY NICO SMIT. WWW.CREStock.COM

Types of Lubricants/Fluids

Most widely used

- ▣ Petroleum Based
- ▣ Petroleum Based with Paraffin

Alternatives

- ▣ Synthetics

Petroleum Based

- ▣ ~ 1/2 of all metal working lubricants are petroleum-based lubricants.
- ▣ Vanishing Oils/Volatile Organic Compounds (VOCs).
- ▣ Smog and Air Contamination.

Petroleum Paraffin Based

- ▣ Some petroleum-based lubricants contain chlorinated paraffins.
- ▣ Industries include: deep drawing, tube bending and cold heading.
- ▣ Carbon range = C10 – C30
- ▣ Chlorine content = 40-70%
- ▣ Evidence of some cancer/health hazards.

Fire Breather

Is paraffin flammable/combustible?



Alternatives To Hydrocarbons

- ▣ Synthetics for Metalworking
- ▣ Vegetable based methyl esters or polymers
- ▣ Sulfur-based materials
- ▣ Phosphoric acid esters

Alternatives

- ▣ Conducted by Institute for Research and Technical Assistance (IRTA)
- ▣ Project was sponsored by U.S. EPA under the Environmental Justice Pollution Prevention program
- ▣ Aim of the project was to investigate, test and demonstrate alternatives to petroleum based VOC emitting lubricants and lubricants containing chlorinated paraffin additives.

Alternatives Study

The companies that used VOC emitting lubricants included:

- ▣ one machine shop
- ▣ one metal nameplate manufacturer
- ▣ one manufacturer of welding torches
- ▣ two aerospace companies

The four companies that used lubricants with chlorinated paraffin additives included:

- ▣ one machine shop
- ▣ one exhaust system manufacturer
- ▣ one deep draw products manufacturer
- ▣ one fastener manufacturer

2001 Study Results

- S&H Machine
- Old: Petroleum Based Lubricant w/
Chlorinated Paraffin Additives
- New: water miscible synthetic lubricant
- 11% cost savings (annually)

2001 Study Results

- Fortner Engineering
- Old: VOC emitting petroleum based lubricant
- New: vegetable-based lubricant
- 40% cost increase (annually)

2001 Study Results

- ▣ Hydro-Aire
- ▣ Old: Petroleum Based Lubricant w/
Chlorinated Paraffin Additives
- ▣ New: vegetable based lubricant
- ▣ 50% cost savings (annually)

2001 Study Results

- Weldcraft
- Old: Petroleum Based Lubricant
- New: vegetable based lubricant
- 0% cost savings (break-even)

2001 Study Results

- Dynaflex Products
- Old: Petroleum Based Lubricant w/
Chlorinated Paraffin Additives
- New: alternative lubricant w/ no chlorinated
paraffins
- 34% cost savings (annually)

2001 Study Results

- B&B Specialties
- Old: Petroleum Based Lubricant w/
Chlorinated Paraffin Additives
- New: alternative polymer lubricant (being tested)
- 50-68% cost savings (estimated, annually)

2001 Study Results

- ▣ Metalite Manufacturing Co.
- ▣ Old: Petroleum Based Lubricant w/
Chlorinated Paraffin Additives
- ▣ New: alternative, paraffin-free lubricant
- ▣ ~0% cost savings (break-even)

Results Summary

- ▣ 4 of 5 Companies Converted to Alternatives
- ▣ 1 of 5 Companies Stopped using chlorinated paraffins
- ▣ 2 of 5 Companies plan to convert to chlorinated paraffin-free lubricants
- ▣ 1 of 5 Companies is considering change.

TCEQ Analysis

- ▣ Low or No VOC Fluids Reduce Ozone.
- ▣ Some Additives Have Low Health Threshold
- ▣ Be Wise!
- ▣ Check ESLs!

Emissions Sources

- ▣ Conventional applications of lubricants and machining fluids are not identified as a significant source of emissions due to the low vapor pressures of the constituents
- ▣ Typically no visible emissions
- ▣ A lubricated production line or machining station that utilizes cutting fluids would be identified as a fugitive source
- ▣ Sources significant enough to require stacks would not be considered fugitive



Infrared Image of Stack Emissions

“Oil Mist” Emissions & Particulate Matter

- ▣ Purposed Oil Mist – 1.0 – 3.0 microns
- ▣ By-product of operation - Particles 10 μ m down to 0.03 μ m
- ▣ Small emissions relative to other processes.
- ▣ 30 TAC 106.4 Limits for Particulate Matter:
- ▣ PM_{2.5} = 10 tons/year
- ▣ PM₁₀ = 15 tons/year

MSS Deadlines

Maintenance, Startup & Shutdown (MSS)

101.222(h) Compliance Dates:

2007 - Petroleum Refineries

2008 - Chemical and Allied Products

2010 - Carbon Black

2011 - Electric Services

2013 - Other Facilities

2014 - Crude Petroleum and Natural Gas facilities
(SB 1134)

Quantification of Emissions

- ▣ Conservative Balance: Usage Rate = Emissions Rate

Usage X weight in lb/gal X individual weight percents

- ▣ Less Conservative Approach Possible

Usage (loaded less the used unloaded) X weight in lb/gal X individual weight percents

Emissions (cont'd)

- ▣ Dry Processes: Assume 100% Emission

Total Mass X weight % of each metal compound =
emissions rate of each metal contaminant
emitted as a particulate matter

Authorization Mechanisms

- ▣ Hierarchy
 - De Minimis (Listed facilities or operations meeting the criteria do not require authorization)
 - Permits by Rule (Pre-written authorizations for specific facilities)
 - Standard Permits
 - New Source Review Permits
- ▣ De Minimis (30 TAC § 116.119 (a)(1))
- ▣ Permit by Rule (30 TAC §106)

Hand-held or manually operated machines

- ▣ 30 TAC § 106.265 - Hand-held or manually operated equipment.
- ▣ This rule is claimed* and records should be maintained that the processes conducted are performed in accordance with the rule

* Doesn't require registration, per se

Hand-held or Manually Operated Machines

- ▣ Qualifications for hand-held or manually operated machine:
- ▣ Involve manual intervention
- ▣ Manual introduction/removal by operator
- ▣ Production lines not covered

Emissions and Distance Limitations

- Do my emissions meet the air rules?
- Rules are air contaminant specific
- Emissions are established by rule paragraph (30 TAC 106.261 and 106.262) or by calculation.

Emissions and Distance Limitations

Example: Water Miscible Cutting Fluid contains mineral oil, and chlorinated paraffins.

Cutting Fluids not listed by ACGIH or Table 262!

- ▣ Chlorine is speciated
- ▣ Authorized by 106.262 ($E = L/K$)
- ▣ ACGIH chlorine threshold = 1.5

Other Mechanisms

- ▣ Standard Permit Revision
- ▣ New Source Review Permit Amendment
- ▣ Maximum Allowable Emission Rates Tables

Summary

- ▣ Synthetic alternatives reduce overall VOC emissions rates
- ▣ Synthetic alternatives can lower costs
- ▣ De Minimis and Permit by Rule (PBR)
- ▣ NSR, Case-by-Case Permit Incorporation
- ▣ Emissions Estimation

References

- ▣ Oil Mist Eliminators. “What is Oil Mist?” Vokes, 2008. Web. 9 Nov, 2011
http://www.vokes-spx.com/gb_oilmist.htm
- ▣ Institute for Research and Technical Assistance, “Alternatives To VOC Emitting Petroleum Based Lubricants and Chlorinated Paraffin Lubricants: Minimizing the Health and Environmental Consequences” Nov, 2004

Questions?

