AIR PERMITTING CASE STUDIES

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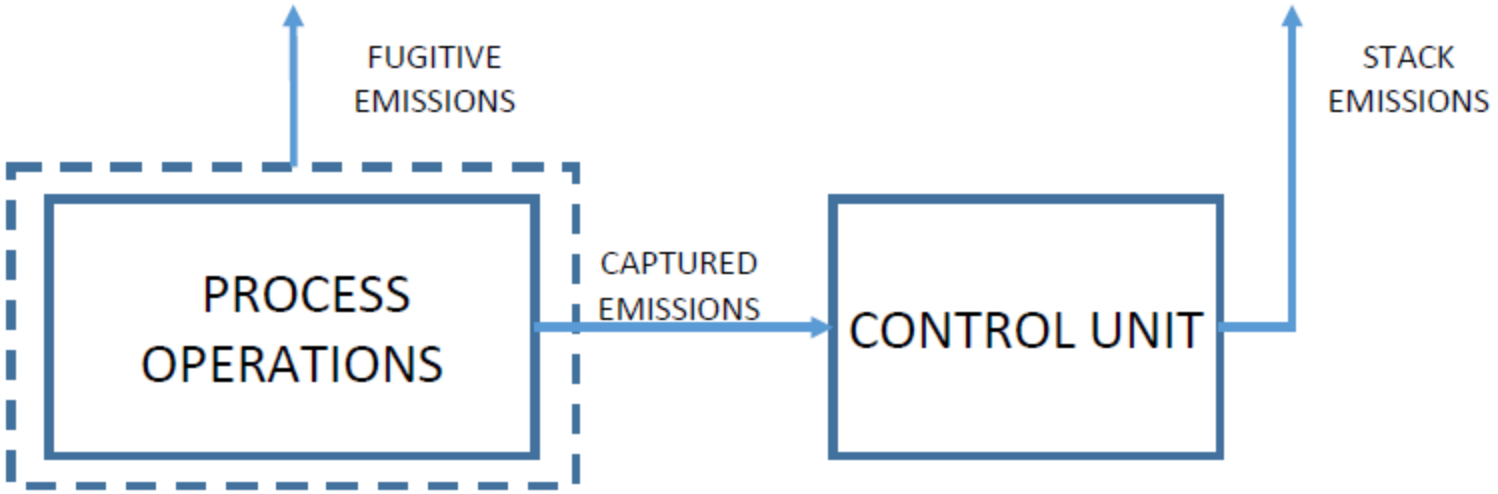
CASE STUDY #1
“BRUSHING UP” ON BASICS

CAPTURE & CONTROL



100 % Capture & 98% Control

METHYL ETHYL KETONE (MEK): VOC +
HAZARDOUS AIR POLLUTANT

TOXICS USE REDUCTION

- USE OF TOXIC: DILUENT CARRIER FOR ADHESIVE APPLICATION TO POLYURETHANE FOAM

- COMPATABILITY WITH FOAM
- DRYING TIME
- SOLVENCY FOR ADHESIVE
  - ADHESIVE CANNOT BE WATER SOLUBLE

TUR PLANNING

- PRIMARY ALTERNATIVES
  - SOLVENT INPUT SUBSTITUTION
  - SCRAP REDUCTION BY EQUIPMENT REDESIGN
- COST OF USING
- MEK
  - SOLVENT PURCHASE PRICE
  - SAFETY SYSTEMS FOR FLAMMABLE SOLVENT
  - AIR POLLUTION CONTROL

STACK TEST REQUIRED BY PERMIT

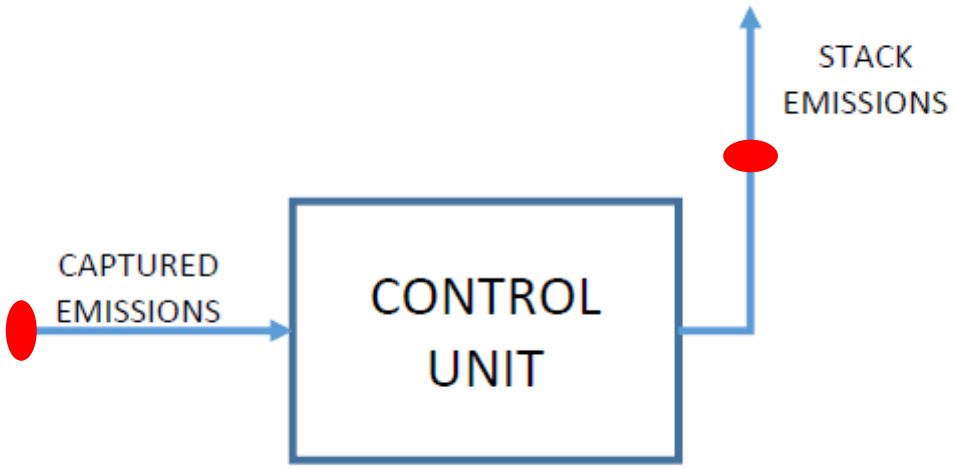
- DESTRUCTION REMOVAL EFFICIENCY (DRE)

  <96%

  CATALYST REPLACEMENT $70,000 !!

FLOW X CONCENTRATION = MASS

$$DRE = \frac{MASS_{IN} - MASS_{OUT}}{MASS_{IN}} \times 100$$

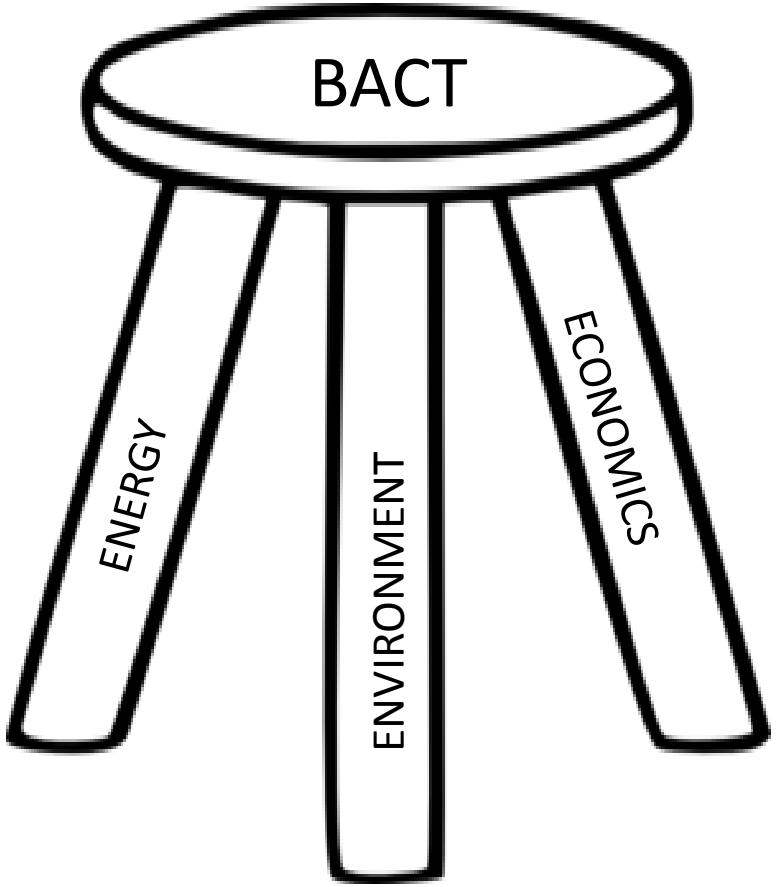


IF YOU WEREN'T EMITTING VOCs…INPUT SUBSTITUTION BACK ON THE TABLE

ACETONE:

- EXEMPT VOC
  - VOLATILE ORGANIC COMPOUND
  - DOES NOT PARTICIPATE IN SMOG REACTION TO FORM OZONE LIKE OTHER VOCS OR NO_X
- TRIALS FIND EFFECTIVE FOR COMPATABILITY WITH FOAM, SOLVENCY AND DRYING TIMES
- FLAMMABLE SOLVENT

BEST AVAILABLE CONTROL TECHNOLOGY (BACT)



STOPPING CATALYTIC INCINERATOR

- ECONOMICS

$150,000 PER YEAR SAVINGS ON NATURAL GAS

- ENERGY

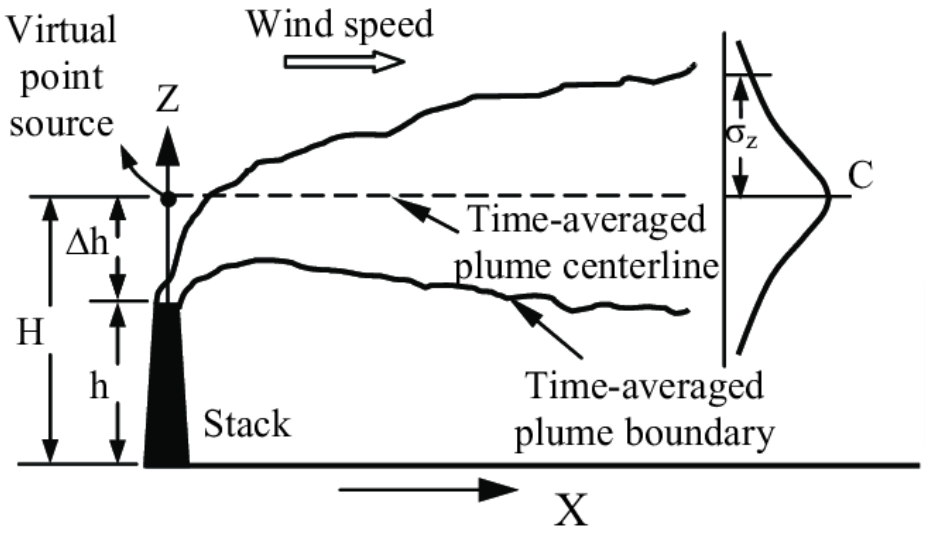
STOPPING CATALYTIC INCINERATOR - ENVIRONMENT

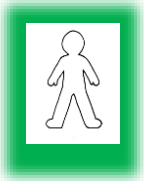
- FUEL COMBUSTION BY-PRODUCTS:
  - CARBON DIOXIDE
  - NOx
  - STILL HAVE TO HEAT BUILDING

REDUCED 95% +

ENVIRONMENT

- NO CONDITION OF AIR POLLUTION





YOUR
NEIGHBOR

- ACETONE AT PROPERTY LINE
  - NOT ABOVE ALLOWABLE AMBIENT LEVELS
  - NOT ABOVE ODOR THRESHOLD

BACT APPROVAL OBTAINED

- MassDEP ARBITRARILY RESTRICTED USAGE TO 50 TONS PER YEAR = 65 PERCENT OF AMOUNT PRESENTED AS POTENTIAL TO EMIT IN APPLICATION.

- OUT OF THE BOX THINKING PRODUCED COST REDUCTIONS THAT SAVED THE BUSINESS AND JOBS!

CASE STUDY #2 MANAGEMENT OF CHANGE - SMALL BUSINESS ENDS UP WITH A BIG PERMIT

BIODIESEL CASE STUDY RECIPE :

1. START WITH A HEAPING AMOUNT OF RAPID GROWTH IN A READY MARKET
2. ADD A HEALTHY SPLASH OF MISPLACED FAITH IN AN ACADEMIC'S (NOT LICENSED P.E.) ADVICE
3. ADD A DASH OF KNOWLEDGE ABOUT ENVIRONMENTAL REGULATIONS
4. STIR RAPIDLY WITH VISIT FROM EPA UNTIL MIXTURE BOILS VIOLENTLY

BIODIESEL PRODUCTION COVERED BY MON NESHAP

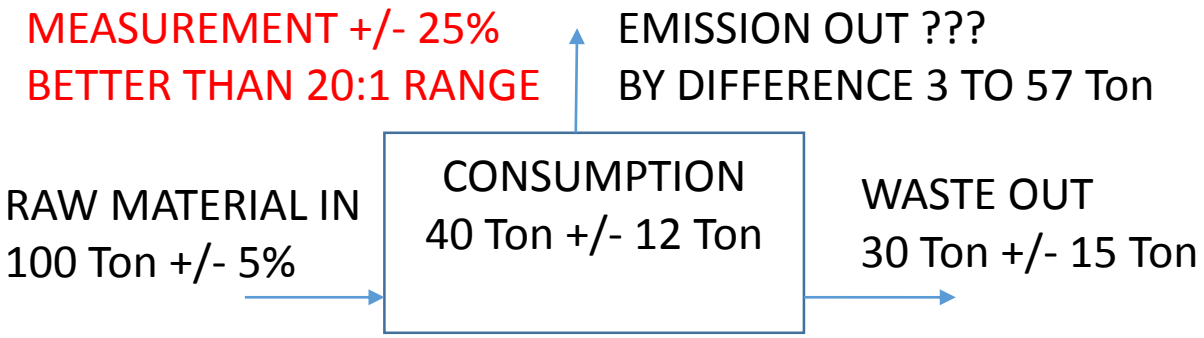
- MON – MISCELLANEOUS ORGANIC CHEMICAL MANUFACTURING
  - NESHAP APPLIES IF FACILITY IS A MAJOR SOURCE
  - MAJOR SOURCE OF HAP IS >=10 TON/YEAR ANY ONE HAP OR >=25 TON/YEAR AGGREGATE HAP
  - METHANOL IS A HAZARDOUS AIR POLLUTANT.

BIODIESEL PRODUCED BY REACTING USED COOKING OIL WITH METHANOL.

1. OIL IS REACTED WITH ACID/METHANOL
2. OIL IS REACTED WITH BASE/METHANOL
3. BIODIESEL SEPARATED FROM GLYCERIN BY SETTLING
4. METHANOL STRIPPED FROM BIODIESEL BY VACUUM

- METHANOL USAGE IS 50+ TON PER YEAR.

MATERIAL BALANCE ESTIMATES



- CHEMICAL ENGINEERING PROFESSOR ASSERTS THAT EMISSIONS ARE “NEGLIGIBLE”.
- EPA VISITS AND DOES ENVELOPE CALCULATION OF USAGE AND AMOUNT CONTAINED IN WASTE = DIFFERENCE OF EMISSIONS IS UPWARD OF 30 TONS/YEAR
- FACILITY MONITORS MATERIAL BALANCE MONTH TO MONTH – EMISSIONS RANGE FROM -5 TON TO +60 TON/YEAR.

EPA AP-42 METHOD FOR CALCULATING EMISSIONS

- VAPOR EQUILIBRIUM FUNCTION OF TEMPERATURE
- ASSUMPTIONS REGARDING COMPOSITION AND IDEAL LAW BEHAVIOR
- WORKING VOLUME AMOUNT DISPLACED W/ FILLING
- (X 0.25 - 1) EQUILIBRIUM ADJUSTMENT BASED ON FEQUENCY OF TANK TURNOVERS
- BREATHING LOSSES WITH TEMPERATURE CHANGE

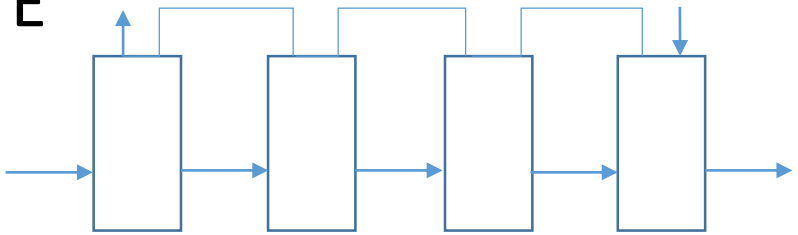
- DOES NOT PREDICT TWO PHASE LIQUID SYSTEMS
- DOES NOT PREDICT VACUUM DISTILLATION PROCESS
- TANK TURNOVER FACTOR FROM API NEVER VALIDATED

ENGINEERING APPROACH

- STACK TESTING FOR MAGNITUDE ASSESSMENT
  - VENT COMPOSITION X DISPLACED VOLUME
    - WASTE TANK DURING FILLING
    - REACTORS DURING FILL
  - MASS EMISSION MEASUREMENT (CRYOGENIC CONDENSER)
    - VACUUM DISTILLATION (AIR LEAKAGE)
    - REACTORS DURING REACTION
- CALCULATIONS
  - AP-42 SUITABLE FOR RAW MATERIAL TANKS
  - LDAR DEFAULT FACTORS USED FOR EQUIPMENT LEAKS

MAJOR SOURCE DESIGNATION

- WITH GROWTH IN PRODUCTION WHILE ASSESSMENT IS ONGOING ACTUAL EMISSIONS TOP 10 TONS PER YEAR
- REACTOR TANK VAPOR BALANCING COULD HAVE REDUCED ACTUAL EMISSIONS BY 75% FOR COST OF PIPING – BUT TOO LATE



- MON NESHAP APPLIES
  - 98 PERCENT CONTROL OF HAP PROCESS EMISSIONS

RECUPERATIVE CATALYTIC INCINERATOR

BURNS PROCESS VENT EMISSIONS 98+% DRE

VFD BLOWER VARIABLE DILUTION AIR VOLUME FLOW FOR BED TEMPERATURE CONTROL

ELECTRIC PREHEATER NO NATURAL GAS

EPA STACK TESTING PLAN
ENGINEERING CHALLENGE – INLET FLOW MEASUREMENT

- AFTER DILUTION AIR INTRODUCED THE FLOW IS VARIABLE WITH VFD BLOWER
  - ❖ STANDARD PITOT TUBE CAN'T BE USED (due to variable flow)
  - ❖ FLOW METER PRESSURE DROP TOO HIGH FOR SYSTEM
  - ❖ FLOW PATH TOO SHORT (for turbine meter/needs at least 10 DD)

MEASUREMENT ERROR +/- 10%

- PRIOR TO DILUTION AIR ENTRANCE
  - ❖ VELOCITY IS TOO LOW TO MEASURE ACCURATELY

STACK TESTING PLAN

PRE-TEST SAMPLING

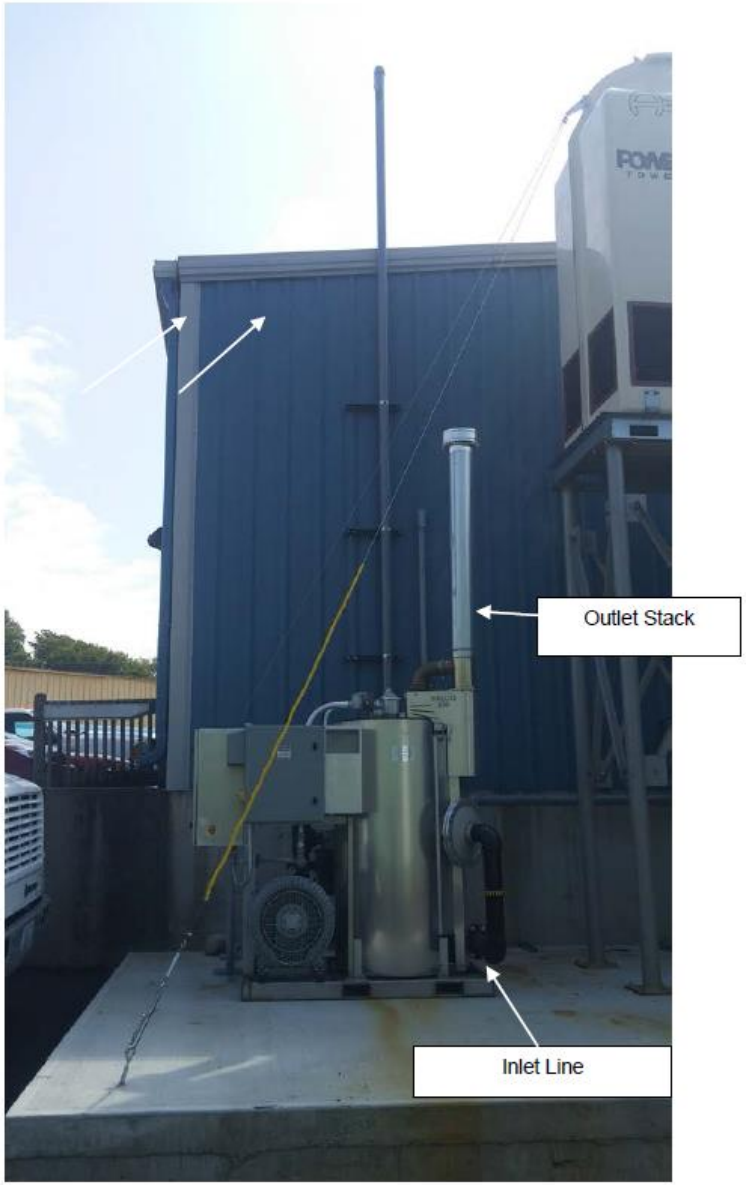
- CHECK PERFORMANCE OF UNIT BEFORE THE OFFICIAL ENFORCEMENT TESTING EVENT
  - ❖ PRACTICE FOR PRODUCTION OPERATIONS TO RUN CONCURRENTLY FOR WORST-CASE
  - ❖ EXPERIENCE ACTUAL RANGES OF INLET AND OUTLET CONCENTRATIONS AND TEMPERATURES
  - ❖ SHAKE OUT BUGS IN THE SAMPLING TRAIN – WITHOUT EPA WATCHING

STACK TESTING PLAN
PRETEST COMPOSITION EVAL.

- SIMULTANEOUS INLET/OUTLET SAMPLING
- ESTABLISH METHOD SELECTION WITH EPA
  - IS METHANOL THE ONLY VOC/HAP?
  - NCASI 98.01 combined with TO-15
- OBTAIN CALIBRATION GAS (CH4) AT SUITABLE CONCENTRATION (10,000ppm inlet / 100ppm outlet)
- Methanol cylinder purchased to determine response factor (0.802 RF) allowing for comparison to alternative limit to DRE of <20ppmvd@3%O2 as methanol.

Result: Methanol represented 97.66% by mass of all compounds VOCs. Method 25A suitable for DRE.

Figure 3-2 Picture of Test Locations - Oxidizer Inlet and outlet



STACK TESTING PLAN

PROCESS CHARACTERIZATION

- HOW TO ESTABLISH WORST-CASE CONDITIONS FOR TESTING ON BATCH DRIVEN OPERATION (10 scenarios identified which were expected to yield majority of emission episodes)
- SCHEDULE PRODUCTION OPERATIONS TO RUN CONCURRENTLY FOR WORST-CASE
- NON-ROUTINE OPERATION - SAFETY REVIEW

EPA STACK TESTING PLAN
Elimination of Flow Measurements (Concentration based DRE)

Irwin Engineers was able to demonstrate through calculation to EPA that inlet and outlet flow would be within 1% while actual flow measurements would likely yield an error of 10% or more due to variable flow rates, low flow rates and poor sampling locations.

As such, VOC DRE was allowed to be calculated based on a ppmvd corrected to a 3% basis. This required simultaneous measurement of VOC, O2 and moisture.

Compliance test yielded a 99.5% VOC/HAP DRE.

EPILOGUE

- AFTER IMPLEMENTING PROCESS CHANGES FOR VENTING AND OXIDIZER CONTROL THE **ACTUAL EMISSIONS** OF METHANOL WERE **LESS THAN 3 TONS** PER YEAR.
- LARGEST COMPONENT OF ACTUAL EMISSIONS = EQUIPMENT LEAKS
- METHANOL NOW BEING 100% RECYCLED BY DISTILLATION ON-SITE
- PRODUCTION CAN INCREASE 10X WITHOUT EXCEEDING 10 TONS
- **AFTER EPA REVERSAL OF ONCE-IN-ALWAYS-IN POLICY RIDEM IS REPERMITTING THE FACILITY AS A MINOR SOURCE.**