The Math of TUR Planning

Presented by:
Mel Kenerson - GZA

Agenda

- Volume to Mass
- % Composition in Raw Materials
- Mass Balance
- Concentration in By-Products
- Production Ratio

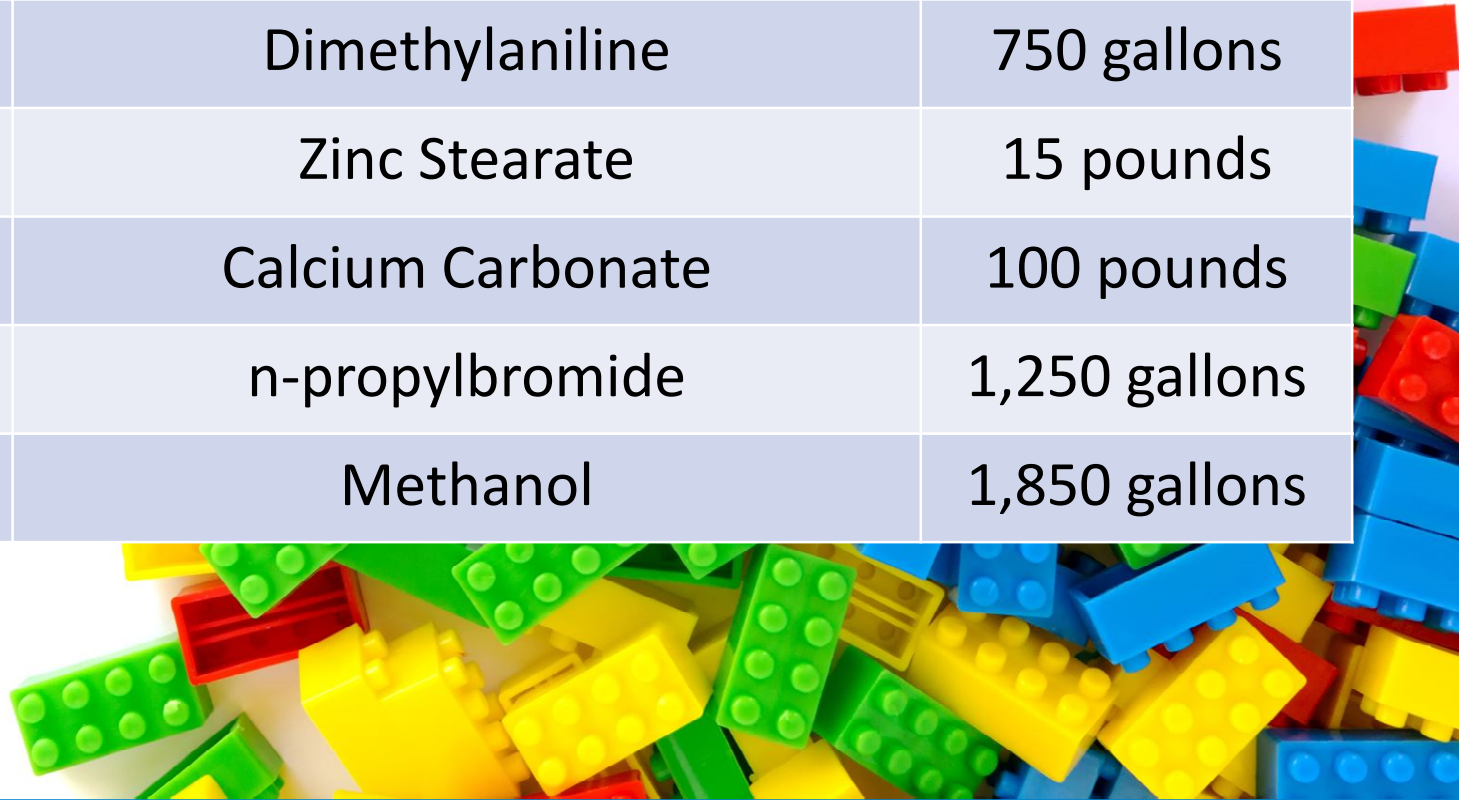
Focus on the MATH, not the PROCESS.

The example process used for this presentation has been developed to suit the purposes of the lesson and support the desired calculations to be reviewed.

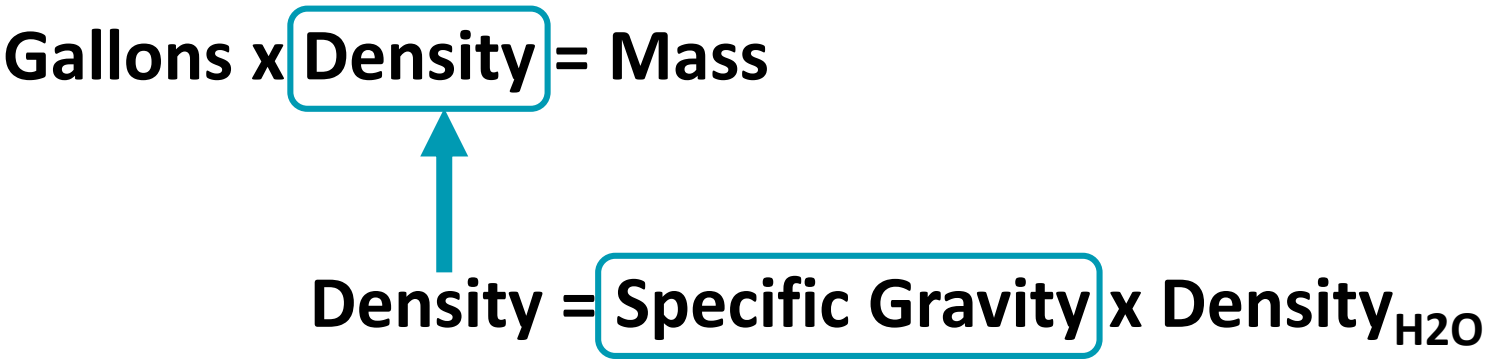
It is not intended to reflect any known facility and may not even be a valid process.

Do We Exceed TURA Reporting Thresholds??

Purpose	Chemical	Amount
In Product	Styrene Monomer	78,000 pounds
In Product	Methyl Ethyl Ketone Peroxide	9,350 gallons
In Product	Dimethylaniline	750 gallons
In Product	Zinc Stearate	15 pounds
In Product	Calcium Carbonate	100 pounds
Cleaning	n-propylbromide	1,250 gallons
Cleaning	Methanol	1,850 gallons



Gallons → Mass



Density or Specific Gravity come from SDS or other available resources.

If given as "relative density", this is treated the same as specific gravity.

Dimethylaniline

From SDS:
- 0.96 SpGr
- >99% DMA

750 gallons

Gallons x Specific Gravity x Density$_{H2O}$ = Mass

750 gal	**0.96**	**8.34#**
		gal

= 6,005 #

Methyl Ethyl Ketone Peroxide

From SDS:
- 8.32 #/gal

9,350 gallons

30 to <40 % ➔ 35%

3. Composition/information on ingredients

Mixtures

Chemical name	Common name and synonyms	CAS number	%
2-Butanone peroxide		1338-23-4	30 to <40
2-butanone		78-93-3	1 to <5
Hydrogen peroxide		7722-84-1	1 to <5
Other components below reportable levels			60 to <70

Gallons x Concentration x Density = Mass

9350 gal	0.35	8.32# / gal

= 27,227 #

YOUR TURN

Go to **Section 1** on the worksheet and complete the 3 problems on that page. Use the calculations we just discussed to determine the pounds of each remaining TUR-listed chemical processed or used.

Processed: 25,000

Chemical	Amount	Pounds
Styrene Monomer	78,000 #	78,000
MEKP (35%)	9,350 gals	27,227
MEK (3%)	9,350 gals	
Dimethylaniline	10 gals	6,005

Otherwise Used: 10,000

Chemical	Amount	Pounds
nPB	1,250 gals	
Methanol	1,850 gals	

Styrene ($C_6H_5CH=CH_2$)

From stack sampling: airborne concentration of 47.5 ppm.

mg/m^3 = (ppm)(molar mass)/24.45 *24.45 L/mol of gas at 25°C and 1 atm*

Molar mass of styrene: C_8H_8

Molar mass of styrene: [(8*12.011) + (8*1.008)] g/mol

Molar mass of styrene: 104.15(2) g/mol

mg/m^3 = 47.5 * 104.152 / 24.45 = 202.34 mg/m^3

Exhaust flow rate: 1500 cfm
Fan operated 3,000 hours for the year

202.34 mg	1500 ft^3	60 min	3,000 hr	m^3	2.2E-6 #	= 3,406 #
m^3	min	hr		3.28^3 ft^3	mg	

Styrene

IN		OUT
Raw Materials 78,000 #	=	Emissions 3,406 #

Section 1: Facility-Wide use of Listed Chemical

c. Amount Manufactured	d. Amount Processed: **78,000 #**
e. Amount Otherwise Used	f. Amount Generated as Byproduct: **3,406 #**
g. Amount Shipped In Or As Product	h. Production or Activity Ratio

Section 2: Materials Balance and Other Reporting Anomolies

a. Amount of Chemical Recycled OnSite	b. Amount of Chemical Consumed Or Transformed
c. Amount of Chemical(Product) Held In Inventory	d. Amount of Chemical Compound
e. Other Amount	

Production Ratio (PR)

$$\frac{\text{Product Made Reporting Year}}{\text{Product Made Previous Year}}$$

Based on unit of product for the Production Unit, NOT chemical used!!

$$\frac{\textbf{2,576 widgets (2022)}}{\textbf{2,123 widgets (2021)}} = \textbf{1.21}$$

$$\frac{\textbf{1,568,245 \# widgets (2022)}}{\textbf{2,314,547 \# widgets (2021)}} = \textbf{0.68}$$

$$\frac{\textbf{0 gallons widgets (2022)}}{\textbf{1,900 gallons widgets (2021)}} = \textbf{0}$$

Methanol

Section 1: Facility-Wide use of Listed Chemical

c. Amount Manufactured	d. Amount Processed
12,189 #	**12,189 #**
e. Amount Otherwise Used	f. Amount Generated as Byproduct
g. Amount Shipped In Or As Product	h. Production or Activity Ratio

2,100 gallons shipped as waste

From waste profile for Waste Flammable Solvents:

- Methanol – 72%
- Isopropanol – 18%

Since density of methanol and isopropanol are very similar: density of waste = methanol (sp.gr 0.79)

2,100 gals	0.72	0.79	8.34 # gal	=9,962#

Methanol

Section 8

Production Related Waste Managed. Enter in Pounds per year (grams of dioxins) (Do not double count: 8.1a - 8.7 should total: (Amount used in production - Amount shipped in product + Amount consumed in production)

Source Reduction and Recycling Activities. Note: Do not double count. (Enter data as pounds per year)	Column A Prior Year	Column B Current Rpt. Year	Column C Following Rpt. Year	Column D 2nd Following Rpt. Year
8.1a Total on-site disposal underground injection & landfills				
8.1b Total on-site disposal or other releases				
8.1c Total off-site disposal underground injection & landfills				
8.1d Total off-site disposal or other releases				
8.2 Quantity used for energy recovery on-site				
8.3 Quantity used for energy recovery off-site				
8.4 Quantity recycled on-site				
8.5 Quantity recycled off-site				
8.6 Quantity treated on-site				
8.7 Quantity treated off-site				
8.8 Quantity released to the environment as a result of remedial actions, catastrophic events, or one-time events not associated with production processes:				0 pounds/year

Don’t Forget Stormwater

A similar approach can be used for TUR-chemicals that are released in stormwater discharges. You will need:

- Quarterly analytical data (typically mg/l)
- Annual storm data (inches of rainfall)
- Area of each drainage area

1. Use average of analytical data (mg/L)
2. Use acreage, runoff coefficient, and rainfall to determine volume of stormwater.
3. mg/L * gallons (& conversion factors) ➔ # released

YOUR TURN

Go to **Section 2** on the worksheet and complete the two problems related to the fate of nPB.

N-propylbromide

C_3H_7Br

nPB Risk Evaluations - TSCA

To calculate average concentration in building

Consider:

1. nPB emissons from equipment
2. Local ventilation
3. Pollution controls

Questions?

Comments?

Lessons Learned?

Thank you!

Please enjoy the rest of the conference!