

$$L_w = 0.0010 M_v P_v Q K_n K_p$$

L_w = working loss. [lb/yr]

M_v = vapor molecular weight. [lb/mole]

P_v = vapor pressure at daily average liquid surface temp. [psia]

Q = annual net through. [bbl/yr]

K_n = working turnovers :

K_p = 1.0 (Appendix A)

$$Q = 400 \left[\frac{m^3}{hr} \right] \times 6.28 \left[\frac{bbl}{1 m^3} \right] \times 24 \left[\frac{hr}{1 day} \right] \times 365 \left[\frac{day}{1 yr} \right] = 2.2 \times 10^7 \left[\frac{bbl}{year} \right]$$

For turnovers $> 36 K_n = (180 + N) / 6 * N$,

$$N = 4 \times 30 \times 12 = 1440, K_n = \frac{180 + 1440}{6 * 1440} = 0.187$$

P_v = 0.002 [psia], (Appendix B)

$$M_v = 130 \left[\frac{lb}{mole} \right], \text{ (Appendix B)}$$

$$L_w = 0.0010 \times 130 \left[\frac{lb}{mole} \right] \times 0.002 [psia] \times 2.2 \times 10^7 \left[\frac{bbl}{yr} \right] \times 0.187 \times 1 \approx 1070 \left[\frac{lb}{yr} \right]$$

$$L_w = 802.23 \left[\frac{lb}{yr} \right] = 0.054 \left[\frac{kg}{hr} \right]$$

$$\text{average Working time} = \frac{3000 [m^3] \text{ average volume}}{400 \left[\frac{m^3}{hr} \right]} = 7.5 [hr]$$

$$\text{Mass flow} \times \text{working time} = 7.5 [hr] \times 0.054 \left[\frac{kg}{hr} \right] = 0.41 [kg]$$

max adsorption efficiency = 10%

$$10 \times 0.41 [kg] = 4.1 [kg] \text{ per day}$$

$$4.1 [kg] \times 180 [day] \approx 740 [kg] \text{ for 6 months}$$

APPENDIX A

K_P = working loss product factor, dimensionless
 for crude oils, $K_P = 0.75$; adjustment of K_P may be appropriate in the case of splash loading into a tank
 for all other organic liquids, $K_P = 1$

APPENDIX B

Table 7.1-2. PROPERTIES (M_V , M_L , P_{VA} , W_L) OF SELECTED PETROLEUM LIQUIDS^{a, c}

Petroleum Liquid Mixture	Vapor Molecular Weight ^a	Liquid Molecular Weight ^b	Liquid Density ^a	ASTM D86 Distillation Slope ^c	Vapor Pressure Equation Constant ^d	Vapor Pressure Equation Constant ^d	True Vapor Pressure (at 60 °F)
	M_V	M_L	W_L	S	A	B	P_{VA}
	lb/lb-mole	lb/lb-mole	lb/gal	°F/vol %	dimensionless	°R	psia
Midcontinent Crude Oil	50	207	7.1	–	Figure 7.1-16	Figure 7.1-16	–
Refined Petroleum Stocks	–	–	–	–	Figure 7.1-15	Figure 7.1-15	–
Motor Gasoline RVP 13	62	92	5.6	3.0	11.644	5043.6	7.0
Motor Gasoline RVP 10	66 ^e	92	5.6	3.0	11.724	5237.3	5.2
Motor Gasoline RVP 7	68	92	5.6	3.0	11.833	5500.6	3.5
Light Naphtha RVP 9-14	–	–	–	3.5	–	–	–
Naphtha RVP 2-8	–	–	–	2.5	–	–	–
Aviation Gasoline	–	–	–	2.0	–	–	–
Jet Naphtha (JP-4)	80	120	6.4	–	11.368	5784.3	1.3
Jet Kerosene (Jet A)	130	162	7.0	–	12.390	8933.0	0.008
No. 2 Fuel Oil (Diesel)	130	188	7.1	–	12.101	8907.0	0.006
No. 6 Fuel Oil ^f	130	387	7.9	–	10.781	8933.0	0.002
Vacuum Residual Oil ^g	190	387	7.9	–	10.104	10,475.5	0.00004

^a References 10 and 11
^b Liquid molecular weights from "Memorandum from Patrick B. Murphy, Radian/RTP to James F. Durham, EPA/CPB Concerning Petroleum Refinery Liquid HAP and Properties Data, August 10, 1993," as adopted in versions 3.1 and 4.0 of EPA's TANKS software.
^c ...
^d ...
^e ...
^f ...
^g ...