This problem corresponds to PEENPP Chapter 49, problem 1.

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Test Bank

Question preview

Question

Leaks have been discovered in piping from a fuel storage depot. The leaking pipes convey no. 2 fuel oil to tanker truck fill stations at the facility. The site is characterized by an unconfined aquifer with an average hydraulic conductivity of 0.42 m/d, a gradient of 0.022, and an effective porosity of 0.28. The average groundwater temperature is 8°C. The density and dynamic viscosity of no. 2 fuel are 900 kg/m^3 and 6.5 × 10^{-13} kg/m·s, respectively. The intrinsic permeability of the soil is most nearly

Answers

(A) 1.4 × 10^{-13} m^2

(B) 3.5 × 10^{-13} m^2

(C) 5.6 × 10^{-13} m^2

(D) 6.9 × 10^{-13} m^2

The answer is (D).

Solution

Content in blue refers to the NCEES Handbook.

Use the equation for finding the hydraulic conductivity to solve for the intrinsic permeability.

$$\begin{aligned}
K &= \text{hydraulic conductivity with water as the fluid} \\
&= 0.42\ \text{m/d} \\
\rho &= \text{fluid density} = 1000\ \text{kg/m}^3 \text{ for water} \\
g &= \text{gravitational acceleration} = 9.81\ \text{m/s}^2 \\
k &= \text{intrinsic permeability, m}^2 \\
\mu &= \text{dynamic viscosity} \\
&= 1.39 \times 10^{-3}\ \text{kg/m·s for water at } 8^\circ\text{C}
\end{aligned}$$

Hydraulic Conductivity

$$\begin{aligned}
K &= \rho g k / \mu \\
k &= \frac{K\mu}{\rho g} \\
&= \frac{\left(0.42\ \frac{\text{m}}{\text{d}}\right)\left(1.39 \times 10^{-3}\ \frac{\text{kg}}{\text{m·s}}\right)\left(\frac{1\ \text{d}}{86\,400\ \text{s}}\right)}{\left(1000\ \frac{\text{kg}}{\text{m}^3}\right)\left(9.81\ \frac{\text{m}}{\text{s}^2}\right)} \\
&= 6.9 \times 10^{-13}\ \text{m}^2
\end{aligned}$$

QUESTION DATA

Vendor
0000153829
Solving Time

Difficulty
easy
Quantitative?
No
Status
Active
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05/23/2019 05:01:26 PM

OTHER VERSIONS

03/04/2019 11:35:28 P (/admin/questions/prev

DISCIPLINES
KNOWLEDGE AREAS
PRODUCTS USED IN

This problem corresponds to PEENPP Chapter 40, problem 2.

Return to Questions (/admin/questions/0?sfield=magento_id&stext=0000153879&sdka=&stype=&sdiff=)

Test Bank Question preview

Question

The chemical characterization of a municipal solid waste is summarized in the following table. The chemical characterization is based on typical published values for the waste components listed.

replace with Question Table (below)

waste component	dry mass (kg/100 kg)	dry elemental chemical composition (%)						
C	H	O	N	S	ash			
food	4.9	48.0	6.4	37.6	2.6	0.4	5.0	
glass/metal	3.2	–	–	–	–	–	100	
paper	12.6	43.5	6.0	44.0	0.3	0.2	6.0	
plastic	8.7	60.0	7.2	22.8	–	–	10	
wood debris	2.1	49.5	6.0	42.7	0.2	0.1	1.5	
yard clippings	29.5	47.8	6.0	38.0	3.4	0.3	4.5	

What is the chemical formula of the waste if sulfur is excluded?

Answers

(A) $C_5H_{32}O_6N$

(B) $C_{11}H_{45}O_{18}N$

(C) $C_{27}H_{92}O_{41}N$

(D) $C_{50}H_{132}O_{61}N$

The answer is (C).

Solution

Find the mass of each component using a 100 kg sample as the basis for calculations.

QUESTION DATA

Vendor
0000153879
Solving Time

Difficulty
easy
Quantitative?
No
Status
Active
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10/10/2018 07:07:02 PM
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05/23/2019 05:01:19 PM
OTHER VERSIONS
DISCIPLINES
KNOWLEDGE AREAS
PRODUCTS USED IN

~~waste component~~	~~dry mass (kg/100 kg)~~	~~elemental chemical mass (kg/100 kg)~~	replace with Answer Table (below)			
~~C~~	~~H~~	~~O~~	~~N~~	~~S~~		
~~food~~	~~4.9~~	~~2.4~~	~~0.31~~	~~1.8~~	~~0.13~~	~~0.020~~
~~glass/metal~~	~~3.2~~	~~–~~	~~–~~	~~–~~	~~–~~	~~–~~
~~paper~~	~~12.6~~	~~5.5~~	~~0.76~~	~~5.5~~	~~0.038~~	~~0.025~~
~~plastic~~	~~8.7~~	~~5.2~~	~~0.63~~	~~2.0~~	~~–~~	~~–~~
~~wood debris~~	~~2.1~~	~~1.0~~	~~0.13~~	~~0.90~~	~~0.0042~~	~~0.0021~~
~~yard clippings~~	~~———~~	~~———~~	~~———~~	~~———~~	~~———~~	~~———~~
	~~61~~	~~28~~	~~3.6~~	~~21~~	~~1.2~~	~~0.14~~

The moisture content is

$$100\ \text{kg} - 61\ \text{kg} = 39\ \text{kg}$$

The chemical content of moisture is

$$\text{hydrogen} = \left(\frac{2}{18}\right)(39\ \text{kg}) = 4.3\ \text{kg}$$

$$\text{oxygen} = \left(\frac{16}{18}\right)(39\ \text{kg}) = 34.7\ \text{kg}$$

The total hydrogen is

$$3.6\ \text{kg} + 4.3\ \text{kg} = 7.9\ \text{kg}$$

The total oxygen is

$$21\ \text{kg} + 34.7\ \text{kg} = 56\ \text{kg}$$

From the values in the table of mass of each component in the 100 kg sample, the following table can be derived.

element	mass (kg)	mole weight (kg/kmol)	kmol	% mass
carbon	28	12	2.3	30
hydrogen	7.9	1	7.9	8.5
oxygen	56	16	3.5	60
nitrogen	1.2	14	0.086	1.3

element	mass (kg)	mole weight (kg/kmol)	kmol	% mass
sulfur	_____	32	0.0044	_____
	93			99.95

From kmol in the table,

element	mole ratio N = 1
carbon	27
hydrogen	92
oxygen	41
nitrogen	1

The chemical formula is $C_{27}H_{92}O_{41}N$.

Erratum 2499 & 2501

Test Bank Question 0000153879

Question Table

Question Table

		Dry Elemental Chemical Composition (%)					
Waste Component	Dry Mass (kg/100kg)	C	H	O	N	S	Ash
Food	4.9	48.0	6.4	37.6	2.6	0.4	5.0
Glass/Metal	3.2	--	--	--	--	--	100
Paper	12.6	43.5	6.0	44.0	0.3	0.2	6.0
Plastic	8.7	60.0	7.2	22.8	--	--	10
Wood Debris	2.1	49.5	6.0	42.7	0.2	0.1	1.5
Yard Clippings	29.5	47.8	6.0	38.0	3.4	0.3	4.5

Answer Table

Answer Table

		Dry Elemental Chemical Composition (%)			
Waste Component	Dry Mass (kg/100kg)	C	H	O	N
Food	4.9	2.4	0.31	1.8	0.13
Glass/Metal	3.2	--	--	--	--
Paper	12.6	5.5	0.76	5.5	0.038
Plastic	8.7	5.2	0.63	2.0	--
Wood Debris	2.1	1.0	0.13	0.90	0.0042
Yard Clippings	29.5	14.1	1.77	11.21	1.003
	61	28	3.6	21	1.2

This problem corresponds to PEENPP Chapter 40, problem 1.

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Test Bank

Question preview

Question

The chemical characterization of a municipal solid waste is summarized in the following table. The chemical characterization is based on typical published values for the waste components listed.

replace with Question Table (below)

waste component	dry mass (kg/100 kg)	dry elemental chemical composition (%)	H	O	N	S	ash
food	4.9	48	6.4	37.6	2.6	0.4	5
glass/metal	3.2						100
paper	12.6	43.5	6.0	44	0.3	0.2	6
plastic	8.7	60	7.2	22.8			10
wood debris	2.1	49.5	6.0	42.7	0.2	0.1	1.5
yard clippings	29.5	47.8	6.0	38	3.4	0.3	4.5

What is the chemical formula of the waste if sulfur is included?

Answers

(A) $C_{50}H_{132}O_{61}N_5S$

(B) $C_{84}H_{265}O_{93}N_{12}S$

(C) $C_{259}H_{848}O_{376}N_{16}S$

(D) $C_{523}H_{1795}O_{795}N_{20}S$

The answer is (D).

Solution

Use a 100 kg sample as the basis for calculations.

replace with Answer Table (below)

(a)

waste component	dry mass (kg/100 kg)	dry elemental chemical composition (%)	H	O	N	S
food	4.9	2.4	0.3	1.8	0.1274	0.0196
glass/metal	3.2					
paper	12.6	5.5	0.8	5.5	0.0378	0.0252

QUESTION DATA

Vendor
0000153880
Solving Time

Difficulty
easy
Quantitative?
No
Status
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Created On
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03/31/2020 05:17:32 PM

OTHER VERSIONS

03/31/2020 12:07:23 A (/admin/questions/prev

DISCIPLINES
KNOWLEDGE AREAS
PRODUCTS USED IN

~~waste component~~	~~dry mass (kg/100 kg)~~	~~dry elemental chemical composition (%)~~	~~H~~	~~O~~	~~N~~	~~S~~
~~plastic~~	~~8.7~~	~~5.2~~	~~0.6~~	~~2.0~~		
~~wood debris~~	~~2.1~~	~~1.0~~	~~0.1~~	~~0.9~~	~~0.0042~~	~~0.0021~~
~~yard clippings~~						
	~~31.5~~		~~1.82~~	~~10.27~~	~~0.17~~	~~0.05~~

The moisture content is

$$100\ \text{kg} - 61\ \text{kg} = 39\ \text{kg}$$

The chemical content of the moisture is

$$\text{hydrogen} = \left(\frac{2}{18}\right)(39\ \text{kg}) = 4.3\ \text{kg}$$

$$\text{oxygen} = \left(\frac{16}{18}\right)(39\ \text{kg}) = 34.7\ \text{kg}$$

The total hydrogen is

$$3.6\ \text{kg} + 4.3\ \text{kg} = 7.9\ \text{kg}$$

The total oxygen is

$$21\ \text{kg} + 34.7\ \text{kg} = 56\ \text{kg}$$

From table (a), the following table can be derived.

(b)

element	mass (kg)	mole weight(kg/kmol)	kmol	% mass
carbon	28	12	2.3	30
hydrogen	7.9	1	7.9	8.5
oxygen	56	16	3.5	60
nitrogen	1.2	14	0.086	1.3
sulfur	_____	32	0.0044	_____
	93			99.95

From kmol in table (b),

element	mole ratioS = 1
carbon	523
hydrogen	1795
oxygen	795
nitrogen	20

element	mole ratioS = 1
sulfur	1

The chemical formula is $C_{523}H_{1795}O_{795}N_{20}S$.

Erratum 2500

Test Bank Question 0000153880

Question Table

Question Table

		Dry Elemental Chemical Composition (%)					
Waste Component	Dry Mass (kg/100kg)	C	H	O	N	S	Ash
Food	4.9	48	6.4	37.6	2.6	0.4	5
Glass/Metal	3.2	--	--	--	--	--	100
Paper	12.6	43.5	6.0	44	0.3	0.2	6
Plastic	8.7	60	7.2	22.8	--	--	10
Wood Debris	2.1	49.5	6.0	42.7	0.2	0.1	1.5
Yard Clippings	29.5	47.8	6.0	38	3.4	0.3	4.5

Answer Table

Answer Table

		Dry Elemental Chemical Composition (%)				
Waste Component	Dry Mass (kg/100kg)	C	H	O	N	S
Food	4.9	2.4	0.3	1.8	0.1274	0.0196
Glass/Metal	3.2					
Paper	12.6	5.5	0.8	5.5	0.0378	0.0252
Plastic	8.7	5.2	0.6	2.0		
Wood Debris	2.1	1.0	0.1	0.9	0.0042	0.0021
Yard Clippings						
	31.5	14.1	1.82	10.27	0.17	0.05

This problem corresponds to PEENPP Chapter 2, problem 1.

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Test Bank Question preview

Question

A 4 in galvanized iron pipe conveys 380 gpm of water over a distance of 1200 ft. The water is at 70°F. Head loss due to flow is most nearly

Answers

(A) 11 ft

(B) ~~13~~ ft

(C) ~~66~~ ft

(D) ~~130~~ ft

The answer is (D).

Solution

Content in blue refers to the NCEES Handbook.

Find the cross-sectional area of the pipe.

$$A = \text{pipe cross sectional area, ft}^2$$
$$D = \text{pipe diameter} = 4 \text{ in}$$

$$A = \frac{\pi D^2}{4} = \frac{\pi(4 \text{ in})^2}{(4)\left(12 \frac{\text{in}}{\text{ft}}\right)^2} = 0.087 \text{ ft}^2$$

Use the continuity equation, and solve for the flow velocity.

$$\text{v} = \text{flow velocity}$$
$$Q = \text{flow rate} = 380 \text{ gpm}$$

Continuity Equation

QUESTION DATA

Vendor
0000158365

Solving Time

Difficulty
easy

Quantitative?
No

Status
Active

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05/23/2019 05:00:52 PM

OTHER VERSIONS

DISCIPLINES

KNOWLEDGE AREAS

PRODUCTS USED IN

$$
\begin{aligned}
Q &= A\mathrm{v} \\
\mathrm{v} = \frac{Q}{A} &= \frac{\left(380\ \frac{\text{gal}}{\text{min}}\right)\left(0.134\ \frac{\text{ft}^3}{\text{gal}}\right)}{\left(0.087\ \text{ft}^2\right)\left(60\ \frac{\text{sec}}{\text{min}}\right)} \\
&= 9.75\ \text{ft/sec}
\end{aligned}
$$

The kinematic viscosity of water at 70°F is 1.059×10^{-5} ft^2/sec. [Properties of Water (English Units)]

Find the Reynolds number.

Reynolds Number (Newtonian Fluid)

$$
\begin{aligned}
\mathrm{Re} &= \mathrm{v}D/v \\
&= \frac{\left(9.75\ \frac{\text{ft}}{\text{sec}}\right)(4\ \text{in})}{\left(1.059 \times 10^{-5}\ \frac{\text{ft}^2}{\text{sec}}\right)\left(12\ \frac{\text{in}}{\text{ft}}\right)} \\
&= 3.06 \times 10^5
\end{aligned}
$$

Find the friction factor. [Moody (Stanton) Diagram]

$$
\begin{aligned}
\varepsilon &= \text{roughness} = 0.0005\ \ (\text{average value}) \\
\varepsilon/D &= \text{relative roughness} = \cancel{0.0005/4} \\
&= \cancel{0.000125} \\
f &= \cancel{0.024}
\end{aligned}
$$

Use the Darcy-Weisbach equation to find the head loss due to flow.

Head Loss Due to Flow

$$
\begin{aligned}
h_f &= f\frac{L}{D}\frac{\mathrm{v}^2}{2g} \\
&= (\cancel{0.024})\left(\frac{(1200\ \text{ft})\left(12\ \frac{\text{in}}{\text{ft}}\right)}{4\ \text{in}}\right)\left(\frac{\left(9.75\ \frac{\text{ft}}{\text{sec}}\right)^2}{(2)\left(32.2\ \frac{\text{ft}}{\text{sec}^2}\right)}\right) \\
&= \cancel{128}\ \text{ft} \quad (\cancel{130}\ \text{ft})
\end{aligned}
$$