RECIRCULATING SAND FILTER SYSTEM COMPONENT QUIZ

12 Hours of CEU credits for the following credentials: **Fee $99.00**

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2. Circle the correct answers and transfer to the answer sheet on the last page.
3. Page down to the last page for the verification forms and mailing instructions.
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INFLUENT FLOWS AND LOADS
Table 1

1. The design wastewater flow (DWF) from one and two-family dwellings must be?
   A. ≤ 2250 gal/per day
   B. ≤ 150 gal/day/bedroom
   C. = Design wastewater flow (DWF)
   D. 150% of estimated wastewater flow in accordance with Table 4 of this manual or s. Comm 83.43 (6), Wis. Adm. Code
2. The design wastewater flow (DWF) from primary treatment tanks must be?
   A. ≤ 2250 gal/per day
   B. ≤ 150 gal/day/bedroom
   C. = Design wastewater flow (DWF)
   D. 150% of estimated wastewater flow in accordance with Table 4 of this manual or s. Comm 83.43 (6), Wis. Adm. Code
3. The design wastewater flow (DWF) from public facilities must be?
   A. ≤ 2250 gal/per day
   B. ≤ 150 gal/day/bedroom
   C. = Design wastewater flow (DWF)
   D. ≥150% of estimated wastewater flow in accordance with Table 4 of this manual or s. Comm 83.43 (6), Wis. Adm. Code
4. The Forward flow must be?
   A. ≤ 2250 gal/per day
   B. ≤ 150 gal/day/bedroom
   C. = Design wastewater flow (DWF)
   D. ≥150% of estimated wastewater flow in accordance with Table 4 of this manual or s. Comm 83.43 (6), Wis. Adm. Code
5. Distribution cell area per orifice size for a sand filter media tank must be?
   A. ≤ 2250 gal/per day
   B. ≤ 4 ft^2
   C. ≥ 4 ft^2
   D. ≤6 ft^2

6. Design loading rate (DLR) for a sand filter media tank must be?
   A. ≤ 5 gpd/ft2 based on forward flow
   B. ≤ 4 ft²
   C. ≥ 5 gpd/ft2 based on forward flow
   D. ≤6 ft²

Table 2 SIZE

7. Surge volume in recirculation tank or chamber must be?
   A. ≥ Depth as required by pump manufacturer
   B. ≥ 2.2 x DWF
   C. ≥ 2/3 DWF
   D. ≥ DWF ÷ 2
8. Reserve volume in recirculation tank or chamber must be?
   A. ≥ Depth as required by pump manufacturer
   B. ≥ 2.2 x DWF
   C. ≥ 2/3 DWF
   D. ≥ DWF ÷ 2
9. Recirculation tank capacity must be?
   A. ≥ Depth as required by pump manufacturer
   B. ≥ 2.2 x DWF
   C. ≥ 2/3 DWF
   D. ≥ DWF ÷ 2
10. Pump protection volume capacity in recirculation tank or chamber
   A. ≥ Depth as required by pump manufacturer
   B. ≥ 2.2 x DWF
   C. ≥ 2/3 DWF
   D. ≥ DWF ÷ 2
11. Orifice spacing along lateral for a sand filter media tank must be?
   A. ≥ 37 inches
   B. ≥ DWF ÷ DLR
   C. ≤ 24 inches
   D. ½ of spacing between laterals or 12 inches, whichever is less
12. Total distribution cell area for a sand filter media tank must be?
   A. ≥ 37 inches
   B. ≥ DWF ÷ DLR
   C. ≤ 24 inches
   D. ½ of spacing between laterals or 12 inches, whichever is less
13. Depth of filter tank for a sand filter media tank must be?
   A. ≥ 37 inches
   B. ≥ DWF ÷ DLR
   C. ≤ 24 inches
   D. ½ of spacing between laterals or 12 inches, whichever is less
14. Spacing between laterals for a sand filter media tank must be?
   A. ≥ 37 inches
   B. ≥ DWF ÷ DLR
   C. ≤ 24 inches
   D. ½ of spacing between laterals or 12 inches, whichever is less

Table 3 OTHER SPECIFICATIONS

15. Depth of stone aggregate over effluent distribution network must be?
    A. ≥ 3 inches
    B. ≥ 24 inches
    C. ≥ 2 inches
    D. ≥ 2 to ≤ 6 inches
    E. ≥ 6 inches
16. Depth of filter media must be?
    A. ≥ 3 inches
    B. ≥ 24 inches
    C. ≥ 2 inches
    D. ≥ 2 to ≤ 6 inches
    E. ≥ 6 inches
17. Depth of stone aggregate under a effluent distribution network must be?
    A. ≥ 3 inches
    B. ≥ 24 inches
    C. ≥ 2 inches
    D. ≥ 2 to ≤ 6 inches
    E. ≥ 6 inches
18. Depth of pea gravel over underdrain pipe must be?
    A. ≥ 3 inches
    B. ≥ 24 inches
    C. ≥ 2 inches
    D. ≥ 2 to ≤ 6 inches
    E. ≥ 6 inches
19. Depth of stone aggregate for underdrain effluent collection must be?
    A. ≥ 3 inches
    B. ≥ 24 inches
    C. ≥ 2 inches
    D. ≥ 2 to ≤ 6 inches
    E. ≥ 6 inches
20. Stone aggregate sieve specifications must be?
    A. ≥ Two 4 inch pipes extending from the filter media aggregate interface to finished grade
    B. Located at a distance equal to approximately 1/6 the distribution cell length from each end along the center of the filter's width
    C. ≥ 5 feet
    D. ≤ 10%
    E. ≤ 15%
    F. Aggregate Maximum/minimum Gradation (ASTM Standard C33, Size 4, coarse aggregate)
21. Difference in flow between any two orifices in the effluent distribution network would be?
    A. ≥ Two 4 inch pipes extending from the filter media aggregate interface to finished grade
    B. Located at a distance equal to approximately 1/6 the distribution cell length from each end along the center of the filter's width
    C. ≥ 5 feet

D. ≤ 10%
E. ≤ 15%
F. Aggregate Maximum/minimum Gradation (ASTM Standard C33, Size 4, coarse aggregate)

22. Difference in flow between any two orifices in a single lateral
A. ≥ Two 4 inch pipes extending from the filter media aggregate interface to finished grade
B. Located at a distance equal to approximately 1/6 the distribution cell length from each end along the center of the filter's width
C. ≥ 5 feet
D. ≤ 10%
E. ≤ 15%
F. Aggregate Maximum/minimum Gradation (ASTM Standard C33, Size 4, coarse aggregate)

23. Head pressure on orifice must be?
A. ≥ Two 4 inch pipes extending from the filter media aggregate interface to finished grade
B. Located at a distance equal to approximately 1/6 the distribution cell length from each end along the center of the filter's width
C. ≥ 5 feet
D. ≤ 10%
E. ≤ 15%
F. Aggregate Maximum/minimum Gradation (ASTM Standard C33, Size 4, coarse aggregate)

24. Location of observation pipes must be?
A. ≥ Two 4 inch pipes extending from the filter media aggregate interface to finished grade
B. Located at a distance equal to approximately 1/6 the distribution cell length from each end along the center of the filter's width
C. ≥ 5 feet
D. ≤ 10%
E. ≤ 15%
F. Aggregate Maximum/minimum Gradation (ASTM Standard C33, Size 4, coarse aggregate)

25. Number of observation pipes must be?
A. ≥ Two 4 inch pipes extending from the filter media aggregate interface to finished grade
B. Located at a distance equal to approximately 1/6 the distribution cell length from each end along the center of the filter's width
C. ≥ 5 feet
D. ≤ 10%
E. ≤ 15%
F. Aggregate Maximum/minimum Gradation (ASTM Standard C33, Size 4, coarse aggregate)

DEFINITIONS

26. Defines a valve that opens to allow effluent from the filter media to be discharged totally to the recirculation tank during low or no wastewater flow conditions.
A. By-pass valve
B. By-pass zone
C. Infiltrative surface
D. Recirculation rate
E. Recirculating sand filter system
F. Recirculation tank

27. Defines a volume of liquid in a recirculation tank that is designed to provide the filter with sufficient liquid to keep the filter active when the recirculation tank is receiving little or no flow from a facility.
    A. By-pass valve
    B. By-pass zone
    C. Infiltrative surface
    D. Recirculation rate
    E. Recirculating sand filter system
    F. Recirculation tank
28. Defines a top layer of media that receives effluent from a distribution network.
    A. By-pass valve
    B. By-pass zone
    C. Infiltrative surface
    D. Recirculation rate
    E. Recirculating sand filter system
    F. Recirculation tank
29. Defines the portion of the wastewater effluent that is delivered back into the system compared to the wastewater effluent that is not delivered back into the system.
    A. By-pass valve
    B. By-pass zone
    C. Infiltrative surface
    D. Recirculation rate
    E. Recirculating sand filter system
    F. Recirculation tank
30. Defines an onsite wastewater treatment component, which contains a recirculation tank and an effluent filtering component which treats wastewater bypassing it through the system more than once.
    A. By-pass valve
    B. By-pass zone
    C. Infiltrative surface
    D. Recirculation rate
    E. Recirculating sand filter system
    F. Recirculation tank
31. Defines the tank which receives effluent from a septic treatment tank and sand filter and doses the sand filter.
    A. By-pass valve
    B. By-pass zone
    C. Infiltrative surface
    D. Recirculation rate
    E. Recirculating sand filter system
    F. Recirculation tank

III. DESCRIPTION AND PRINCIPLE OF OPERATION

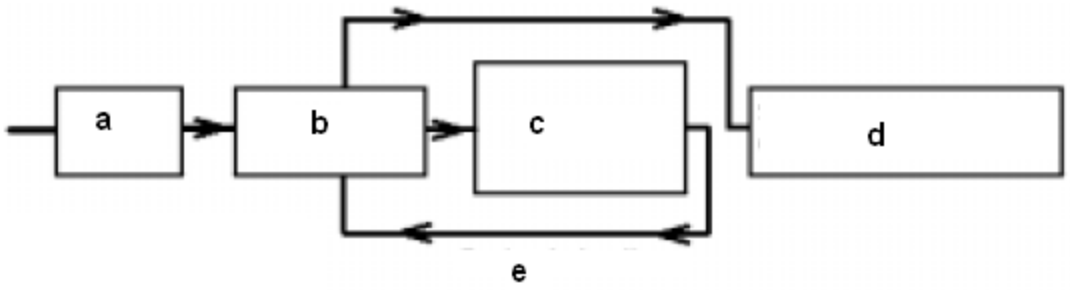
32. POWTS recirculating sand filter system component operation consists of a recirculation tank or chamber and a fixed film aeration process unit in which wastewater passes through a porous media.
    A. true
    B. false
33. Oxygen diffuses into the thin film of vapor as air passes through the media by convection due to temperature differences.

A. true
B. false

34. The filter is of such coarse material, that orifices may only cover forty square feet of surface area.
A. true
B. false

35. Physical entrapment, increased retention time, and conversion of pollutants in the wastewater are important treatment objectives accomplished under unsaturated conditions.
A. true
B. false

Figure 1 indicates the flow path of a recirculating sand filter system.
Use diagram for questions 36-40



36. Letter 'a' represents _____

37. Letter 'b' represents _____

38. Letter 'c' represents _____

39. Letter 'd' represents _____

40. Letter 'e' represents soil _____

IV DESIGN

41. Recirculating Sand Filter System Component Design – Detailed plans and specifications must be developed, reviewed and approved by the governing unit having authority over the plan for the installation. A Sanitary Permit must also be obtained from the department or governmental unit having jurisdiction.
A. true
B. false

42. Design of the recirculating sand filter system component is based on the estimated wastewater flow. It must be sized such that it can accept the daily wastewater flow at a rate that will provide treatment.
A. true
B. false

43. One and two-family dwellings. The infiltrative surface size for one and two-family dwelling application is determined by calculating the designed wastewater flow (DWF).

A. true
B. false

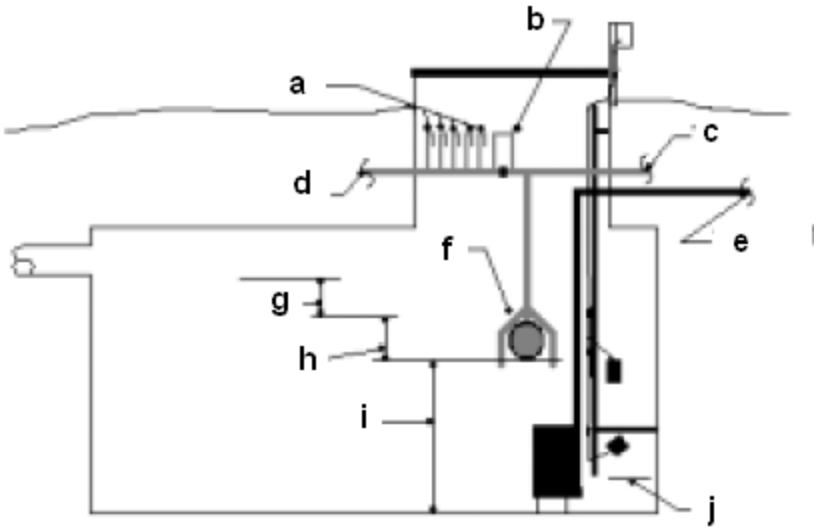
Step B. Design of the Recirculation Tank or Chamber

44. This section determines the required liquid capacity and depth of the recirculation tank or chamber as well as the operation elevation of the by-pass valve, high water alarm and low level emergency pump cut off.

A. true
B. false

Figure 2 – Cross section of recirculation tank

Use for questions 45-54



45. Letter ‘a’ represents _____

46. Letter ‘b’ represents _____

47. Letter ‘c’ represents _____

48. Letter ‘d’ represents _____

49. Letter ‘e’ represents _____

50. Letter ‘f’ represents _____

51. Letter ‘g’ represents _____

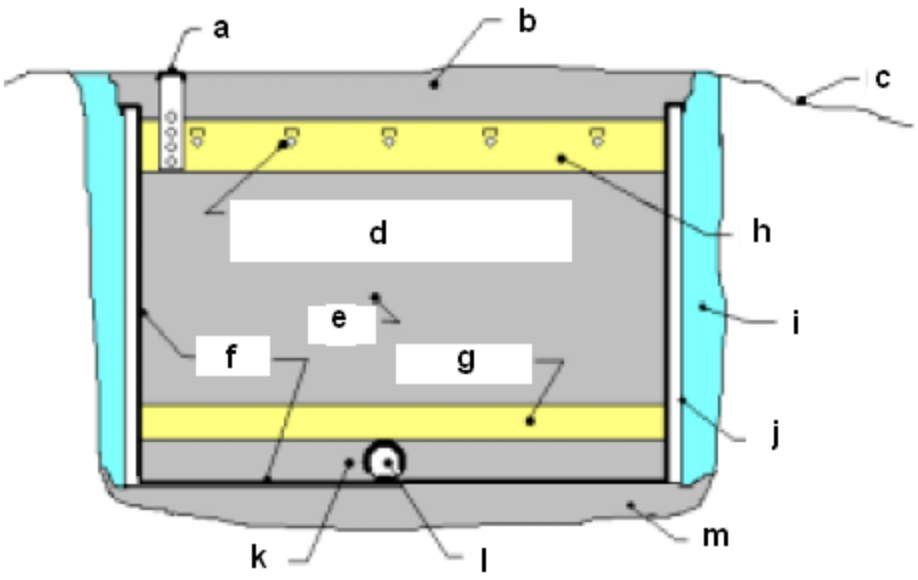
52. Letter ‘h’ represents _____

53. Letter ‘i’ represents _____

54. Letter 'j' represents _____

55. Minimum liquid capacity of recirculation tank or chamber = 2.2 x DWF
    A. true
    B. false
56. Gallons per inch of tank or chamber = capacity in gallons × liquid depth in inches.
    A. true
    B. false
57. The volume of a single dose is determined by multiplying the 2/3 of the DWF by the recirculation rate then dividing by the number of doses per day. Number of doses per week must between 24 and 48.
    A. true
    B. false
58. Reserve zone capacity = DWF × 2
    A. true
    B. false
59. Elevation at which the by-pass valve opens = Elevation required in the tank to hold a volume of liquid equal to the DWF
    A. true
    B. false
60. The minimum elevation of the inlet invert is determined by dividing the sum of the required volumes of the by-pass valve zone, surge zone, and reserve zones by the gallons per inch value of the tank.
    A. true
    B. false

Step C. Design of the Recirculating Sand Filter Component
Fig. 3 – Formed sand filter
Use diagram for question 61-73



61. Letter ‘a’ represents _____

62. Letter ‘b’ represents _____

63. Letter ‘c’ represents _____

64. Letter ‘d’ represents _____

65. Letter ‘e’ represents _____

66. Letter ‘f’ represents _____

67. Letter ‘g’ represents _____

68. Letter ‘h’ represents _____

69. Letter ‘i’ represents _____

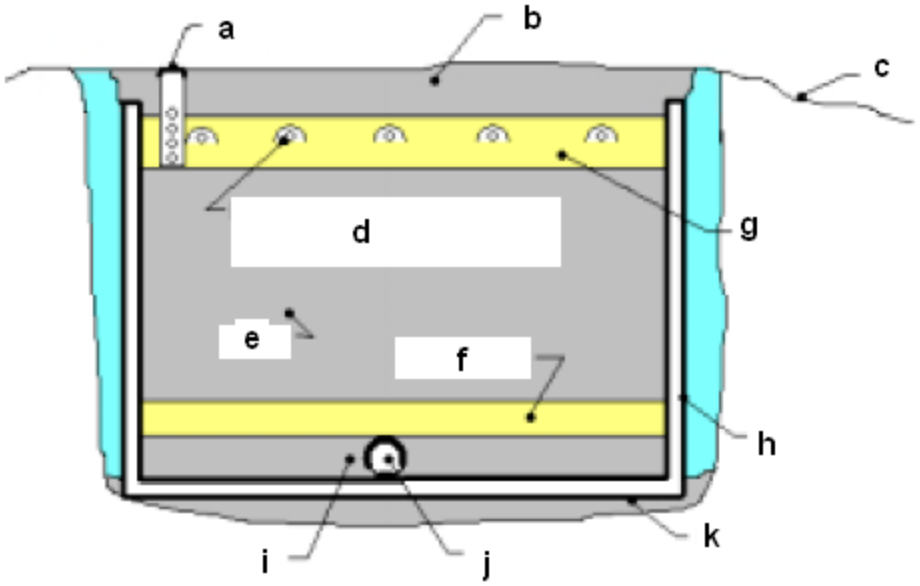
70. Letter ‘j’ represents _____

71. Letter ‘k’ represents _____

72. Letter ‘l’ represents _____

73. Letter ‘m’ represents _____

Fig. 4 – Sand filter in a tank
Use diagram for question 74-77



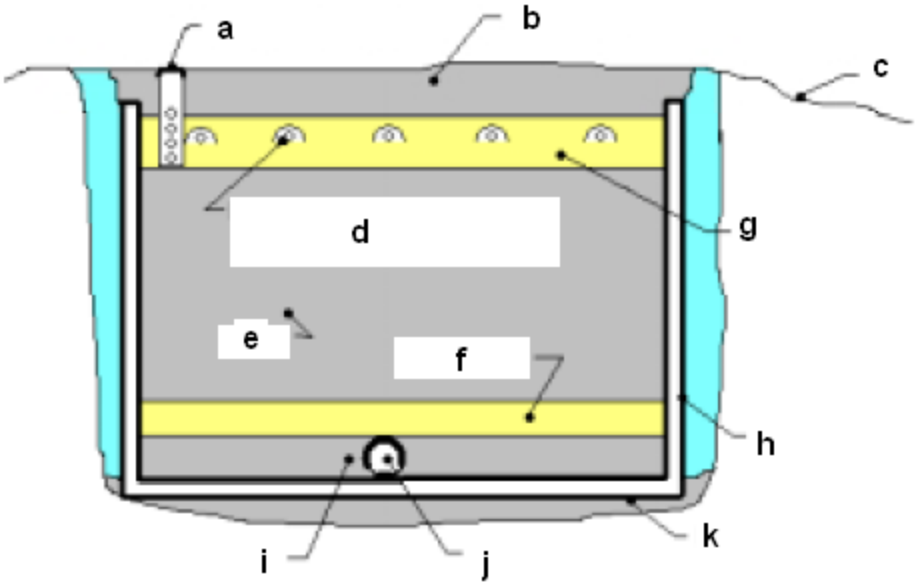
74. Letter ‘a’ represents _____

75. Letter ‘b’ represents _____

76. Letter ‘c’ represents _____

77. Letter ‘d’ represents _____

Fig. 4 – Sand filter in a tank
Use diagram for question 78-84



78. Letter ‘e’ represents_____

79. Letter ‘f’ represents _____

80. Letter ‘g’ represents_____

81. Letter ‘h’ represents_____

82. Letter ‘i’ represents_____

83. Letter ‘j’ represents _____

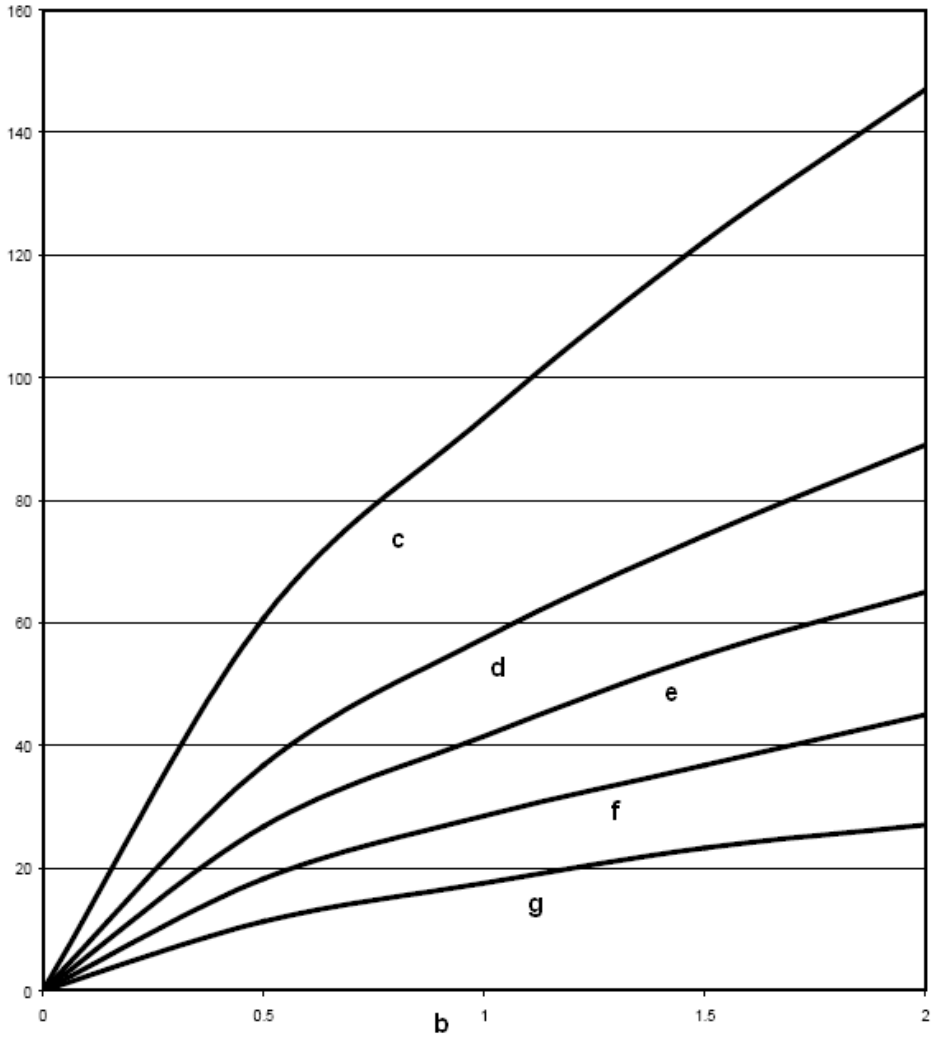
84. Letter ‘k’ represents _____

85. The minimum distribution cell area is calculated by dividing the design wastewater flow by a design loading rate of 5gpd/ft2.

A. true
B. false

86. The sand filter container is a watertight closed top vessel.
    A. true
    B. false
87. A 4" underdrain pipe with slots or holes is placed on the bottom of the container to collect the filtered effluent. Installation orientation of the slots or holes must be on the bottom of the underdrain pipe. The collection pipe extends outside the sand filter container to the recirculation tank.
    A. true
    B. false
88. A layer of stone aggregate meeting the specifications listed in Table 1 is placed in the bottom of the tank to a depth of at least equal to the bottom of the collection pipe. The stone aggregate provides a means for the filtered effluent to flow to the collection pipe.
    A. true
    B. false
89. A layer of pea gravel meeting the specifications listed in Table 3 is placed over the effluent collection stone aggregate and filtered effluent collection pipe to a depth of at least three inches. The pea gravel acts a barrier so the filter media does not migrate into the collection stone aggregate and pipe.
    A. true
    B. false
90. A three-foot layer of sand media meeting the specifications listed in Table 1 is placed on top of the pea gravel to provide filtration and treatment of the effluent. The top of the filter media is leveled.
    A. true
    B. false
91. The distribution network spreads the septic tank effluent as uniformly as possible over the sand filter surface. The network consists of a manifold and laterals. Typical design consists of:
    A. Orifices - orifices shall be located upward with orifice shields or a half pipe protecting the orifices from becoming blocked by aggregate.
    B. Laterals – laterals are spaced two feet apart, with an upturned long sweep elbow and valve for clean out. The lateral length can not exceed that indicated in Graph 1 for various diameters. Laterals are sloped back in order to provide drainage of the lateral between doses.
    C. Manifold – manifolds slope back to provide drainage of the manifold between doses. The manifold is sized using Table 5.
    D. all of the above.
92. The distribution network spreads the septic tank effluent as uniformly as possible over the sand filter surface. The network consists of a manifold and laterals. Typical design consists of:
    A. Force main – Force mains slope back to provide drainage of the force main between doses. The force main is sized using Table 6.
    B. Recirculation tank pump - the pump is sized to meet flow rate and lateral pressure of at least five feet at distal end.
    C. both A & B
    D. A only
    E. B only

Graph 1
Minimum Lateral Diameter Based on Orifice Spacing for 1/8" Diameter Orifices
Use below diagram for question 93-98



93. Letter ‘a’ represents _____

94. Letter ‘b’ represents _____

95. Letter ‘c’ represents _____

96. Letter ‘d’ represents _____

96. Letter ‘e’ represents _____

97. Letter ‘f’ represents _____

98. Letter ‘g’ represents _____

Table 5
Maximum Manifold Length Based on Individual Lateral Flow Rates
Use below diagram for questions 99-106

Table 5 Maximum Manifold Length Based on Individual Lateral Flow Rates and h					
a		d	e	f	g
b	c	Diameter Manifold	Diameter Manifold	Diameter Manifold	Diameter Manifold
10	5	6 ft	8 ft	12 ft	18 ft
20	10	4 ft	6 ft	8 ft	14 ft
30	15	2 ft	4 ft	6 ft	12 ft
40	20	2 ft	2 ft	6 ft	10 ft
50	25	NP[a]	2 ft	4 ft	8 ft
60	30	NP	2 ft	4 ft	8 ft
70	35	NP	NP	2 ft	6 ft
80	40	NP	NP	2 ft	6 ft
90	45	NP	NP	2 ft	6 ft
100	50	NP	NP	2 ft	4 ft

99. Letter ‘a’ represents _____

100. Letter ‘b’ represents _____

101. Letter ‘c’ represents _____

102. Letter‘d’ represents _____

103. Letter ‘e’ represents _____

104. Letter ‘f’ represents _____

105. Letter ‘g’ represents _____

106. Letter ‘h’ represents_____

Table 6
Friction Loss (foot/100 feet) in Plastic Pipe
Use below diagram for questions 107-113

Table 6
Friction Loss (foot/ a feet) in Plastic Pipe[a]

g	f				
c	e	1-1/2"	2"	3"	4"
10	2.50				
11	2.99				
12	3.51				
13	4.07				
14	4.66	1.92			
15	5.30	2.18			
16	5.97	2.46			
17	6.68	2.75			
18	7.42	3.06			
19	8.21	3.38			
20	9.02	3.72			
25	13.63	5.62	1.39		
30	19.10	7.87	1.94		
35	25.41	10.46	2.58		
40	32.53	13.40	3.30		
45	40.45	16.66	4.11		
50	49.15	20.24	4.99		
60		28.36	7.00	0.97	
70		37.72	9.31	1.29	
80	Velocities in this area exceed d ft		11.91	1.66	
90	per second, which are not acceptable		14.81	2.06	
100	velocity for this pipe diameter		18.00	2.50	0.62

Velocities in this area are below b feet per second

Note a: Table is based on Hazen – Williams formula: $h = 0.002082L \times (100/C)^{1.85} \times (gpm^{1.85} \div d^{4.8655})$
Where: h = Feet of head L = Length in feet
C = Friction factor from Hazen – Williams (145 for plastic pipe)
gpm = gallons per minute d = Nominal pipe size

107. Letter 'a' represents _____

108. Letter 'b' represents _____

109. Letter 'c' represents _____

110. Letter'd' represents _____

111. Letter 'e' represents _____

112. Letter 'f' represents _____

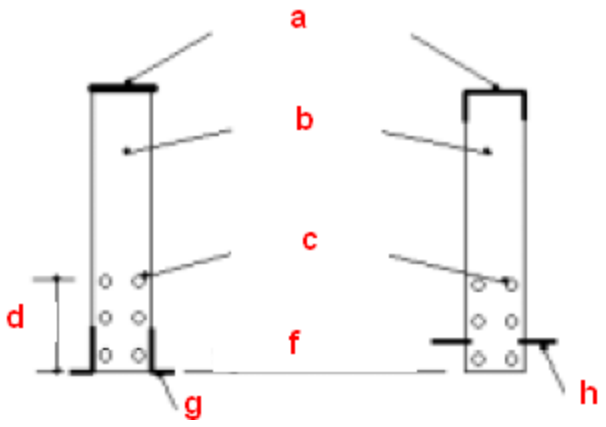
113. Letter 'g' represents _____

114. At least ____ observation pipes are placed extending from the top of the filter media/stone aggregate interface to finish grade to monitor for ponding and/or formation of a clogging mat.

A. 1
B. 2
C. 3
D. 4

115. The pipes must be secured and have perforations in the bottom ____ inches.
A. 1
B. 2
C. 3
D. 4

Fig. 5 – Observation pipes
Use diagram below for question 116-123



116. Letter 'a' represents _____

117. Letter 'b' represents _____

118. Letter 'c' represents _____

119. Letter'd' represents _____

120. Letter 'f' represents _____

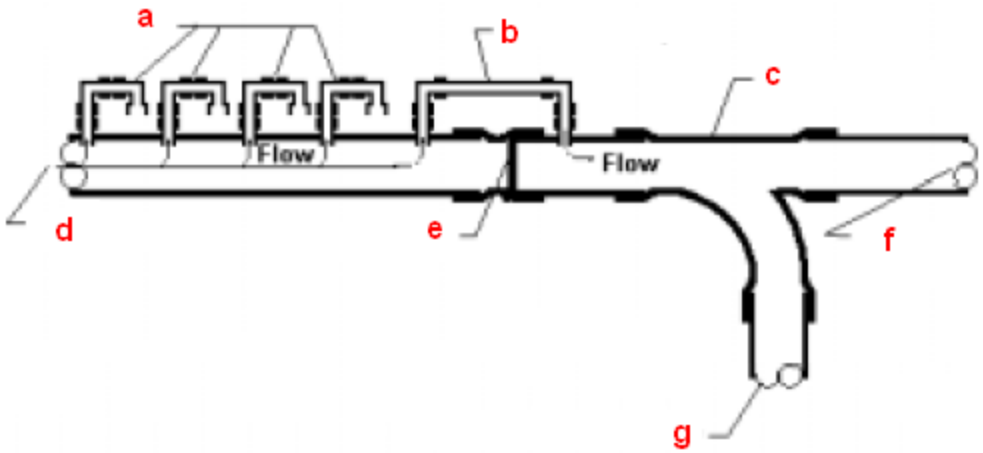
121. Letter 'g' represents _____

122. Letter 'h' represents _____

123. The sand filter effluent drains by gravity through the recirculation tank. The filtered effluent drain pipe is installed with a means of diverting 55 to 65% of the effluent to the recirculation tank and with a low liquid level by-pass valve to divert all of the effluent into the recirculation tank during low or no flow conditions.
A. true
B. false

124. The filtered effluent drain pipe diverts 55 to 65% of the effluent into the recirculation tank by the use of a special flow splitter fitting.
A. true
B. false

Fig. 6 – Flow splitter fitting using pipe fittings
Use below diagram for questions 125-



125. Letter 'a' represents _____

126. Letter 'b' represents _____

127. Letter 'c' represents _____

128. Letter 'd' represents _____

129. Letter 'e' represents _____

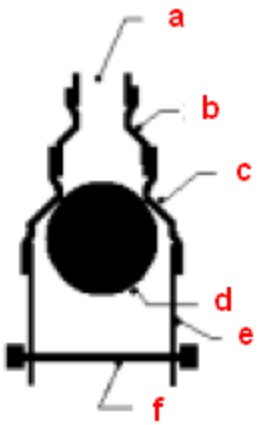
130. Letter 'f' represents _____

131. Letter 'g' represents _____

132. The pipe connecting the by-pass valve to the discharge pipe is installed on the discharge side of the flow control fitting by the use of a short turn tee fitting.

A. true
B. false

Fig. 8 – By-pass valve using float ball
Use below diagram for questions 133-138



133. Letter ‘a’ represents _____

134. Letter ‘b’ represents _____

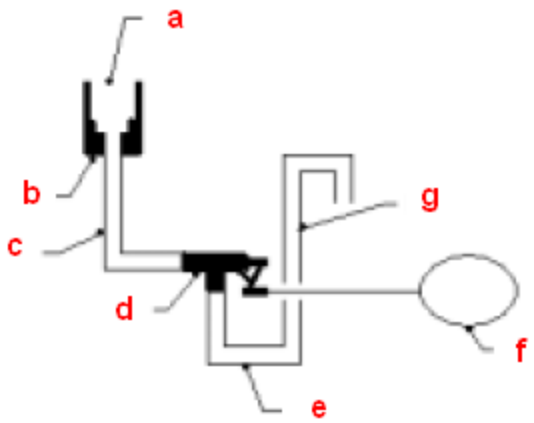
135. Letter ‘c’ represents _____

136. Letter ‘d’ represents _____

137. Letter ‘e’ represents _____

138. Letter ‘f’ represents _____

Fig. 9 – By-pass valve using float valve
Use below diagram for questions 139-145



139. Letter ‘a’ represents _____

140. Letter ‘b’ represents _____

141. Letter ‘c’ represents _____

142. Letter ‘d’ represents _____

143. Letter ‘e’ represents _____

144. Letter ‘f’ represents _____

145. The cover over the distribution net work must extend to final grade and be of either wash aggregate or decorative rock. All surface waters must be diverted away from the sand filter.

A. true
B. false

146. The sand filter is dosed by timed doses. The recirculation tank or chamber must provide for surge loading and surge (forward) volumes.

A. true
B. false

147. The excavation for a recirculating sand filter is made 6" to 12" larger than the filter. Untreated plywood, wafer board or other suitable material is formed into a box to support the liner and allow the liner to be draped over the top. Only sand is placed between the frame and soil to protect the liner after the plywood has decomposed. Approximately 1" of sand is placed in the bottom of the excavation prior to placement of the liner. The top of the liner must be above the seasonal high water table so groundwater does not flow into the sand filter.

A. true
B. false

148. Recirculating sand filter system. Install a four inch diameter underdrain filtered effluent collection pipe with slots or holes by placing it on the bottom of the sand filter tank and connecting it to solid wall pipe prior to exiting the tank. The installation orientation of the slots or holes must be on the side of the underdrain pipe. The opening in the tank wall shall be sealed by use of a gasket.

A. true
B. false

149. The component owner is responsible for the operation and maintenance of the system. The county, department or POWTS service contractor shall make periodic inspections of the components, and effluent levels, etc.

A. true
B. false

150. Design approval and site inspections before, during, and after the construction are accomplished by the county or other appropriate jurisdictions in accordance to Comm 83 of the Wis. Adm. Code.

A. true
B. false

151. The septic and recirculation tanks are to be inspected and maintained at least every three years. If the scum and sludge occupies 1/3 of the tanks' volume, the tank shall be pumped and its contents properly disposed of. If the tank is not pumped at this time, it shall be pumped when the scum and sludge occupies 1/3 of the tanks' volume.

A. true
B. false

152. Inspections of recirculating sand filter component performance is required at least every six months for the first two years. Then once a year for the next two years. Then once every three years, thereafter. These inspections include checking the liquid levels in the observation pipes and examination for any seepage around the filter.

A. true
B. false

153. User's Manual: A user's manual is to accompany the recirculating sand filter component. The manual is to contain the following as a minimum:

A. Diagrams of all system components and their location.
B. Specifications for electrical and mechanical components.
C. Names and phone numbers of local health authority, component manufacturer or management entity to be contacted in the event of a failure.
D. Information on the periodic maintenance of the recirculating sand filter system, including electrical and mechanical components.
E. none of the above
F. all of the above

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