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Continuing Education Course #389
Overview of Alternative Desalination Technologies

1. What percentage of worldwide water supply is currently provided by desalination?
 - a. > 50%
 - b. 20%
 - c. 10%
 - d. 5%

2. What percentage of the worldwide water resources are in brackish water aquifers?
 - a. 10%
 - b. 1%
 - c. 45%
 - d. 97.5%

3. What is the maximum TDS concentration of drinking water according to the US EPA Safe Drinking Water Act's drinking water standard?
 - a. 500 ppt
 - b. 50 ppt
 - c. 1,000 ppt
 - d. 100 ppt

4. Salinity of seawater varies both seasonally and geographically. Which of the following natural water bodies has the highest salinity?
 - a. Atlantic Ocean
 - b. Caribbean Sea
 - c. Arabian Gulf
 - d. Pacific Ocean

5. Reverse osmosis separation is cost-effective for saline source water with TDS concentration in a range of:
 - a. 1 to 800
 - b. 50 to 46,000
 - c. 200 to 3,000
 - d. 20,000 to 100,000

6. The gained output ratio (GOR) of mechanical vacuum compression (MVC) desalination system varies between:
 - a. 4 and 12
 - b. 3 and 15
 - c. 5 and 20
 - d. 20 and 40

7. In multi-stage flash distillation, water is heated to a temperature of between:

- a. 40 - 62 °C
- b. 62 - 75 °C
- c. 75 - 90 °C
- d. 90 - 115 °C

8. The first MSF plant was built in the Kingdom of Saudi Arabia (KSA) in:

- a. 1907
- b. 1930
- c. 1955
- d. 1965

9. In multiple effect distillation (MED) systems, the maximum brine concentrate temperature is between:

- a. 40 - 62 °C
- b. 62 - 75 °C
- c. 75 - 90 °C
- d. 90 - 115 °C

10. Which one of the following statements is not correct:

- a. MSF desalination systems are more reliable than MED systems
- b. MSF has enhanced plant efficiency due to larger heat exchanger and more stages
- c. MSF distillation systems have lower capital and O&M costs than MED systems
- d. MSF systems are easier to operate using lower skilled staff

11. Which of the following statements is correct - Vacuum Compression (VC) process is used in:

- a. thermal desalination plants
- b. electro dialysis reversal plants
- c. wastewater treatment plants
- d. reverse osmosis desalination plants

12. Approximately how much salt removal can a single set of EDR stacks achieve?

- a. 50%
- b. 75%
- c. 87.5%
- d. 95%

13. Which one of the following desalination technologies is most beneficial for production of water used in agricultural applications?

- a. Multi-stage flash distillation (MSF)
- b. Multi-effect distillation (MED)
- c. Electrodialysis / Electrodialysis reversal (EDR)
- d. Reverse Osmosis (RO)

14. EDR is more suitable than RO for production of desalinated water if:

- a. the Total Organic Carbon (TOC) removal from source water has to be > 95%
- b. the source water has salinity (TDS concentration) lower than 3,000 mg/L
- c. pathogen removal of over 99% has to be achieved by the desalination system
- d. the source water has salinity of 46,000 mg/L or more

15. Which one of the following treatment processes is not typically used for pretreatment of seawater in reverse osmosis desalination plants:

- a. limestone contactors
 - b. lamella settlers
 - c. dissolved air flotation clarifiers
 - d. granular media filters
16. Which one of the following factors does not impact the required seawater feed pressure of the SWRO system?
- a. the source water salinity
 - b. the source water temperature
 - c. the source water odor
 - d. the permeability of the RO membranes
17. Which one of the following performance parameters does not pose a limitation for standard RO membrane elements?
- a. feed pressure of > 83 bars
 - b. feed water salinity of < 30,000 mg/L
 - c. silt density index > 4
 - d. feed water temperature of > 45° C
18. The target design RO system recovery rate is inversely proportional to the:
- a. source water salinity and fouling potential
 - b. content of oil in the source saline water
 - c. dosage of coagulant for source water conditioning
 - d. source water pH
19. Hybrid SWRO-thermal desalination plants have found application mainly for:
- a. brackish water desalination
 - b. desalination of seawater with high oil content
 - c. locations with limited existing generation capacity for both water and power
 - d. water supply of small coastal cities
20. Which of the desalination technologies listed below yields the lowest overall fresh water production cost?
- a. SWRO
 - b. BWRO
 - c. VC
 - d. MED
21. For a 200 MLD desalination plant, which technology provides the lowest cost of water?
- a. Hybrid SWRO-thermal desalination
 - b. SWRO
 - c. MED-TVC
 - d. MSF
22. What is the maximum capacity of an individual SWRO facility?
- a. 26 MGD
 - b. 128 MGD
 - c. 256 MGD
 - d. 400 MGD
23. Which one of the following statements is true:
- a. The cost of water production by thermal desalination is not sensitive to source water quality
 - b. MSF evaporation is more competitive than MED-TVC technology for small and medium size desalination

projects

- c. Engineering cost is the largest capital cost component of desalination projects
- d. Energy costs are less than 10% of the total fresh water production acosts of SWRO desalination facilities

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