Outline

- Major Thermal Desalination Plants Users
- Multi Stage Flash Evaporation Process
- Multi Effect Desalination Process
- Common operating problems and major challenges.
Major Thermal Desalination Plants Users

Figure 18: Top 10 countries by total installed thermal capacity since 1945

Saudi Arabia
United Arab Emirates
Kuwait
Qatar
Libya
Bahrain
Oman
Italy
United States of America
Netherlands Antilles

million m³/d
Thermal Desalination Processes

Designed to desalinate seawater to produce high quality water (TDS < 5 ppm) that can be used as:

- Boiler Feedwater
- Injected in Processes
- Drinking water
Multi Stage Flash Evaporators  Desalination Plant, Dubai
Multi Stage Flash Evaporators Process

• Pretreatment System
  • Seawater intake
  • Filtration
  • Chlorination

• Multi Stage Flash Evaporation Main Components
  • Flash evaporators chambers
  • Brine heater
  • Ejector system for vacuum and removal of non-condensable gasses
Multi Stage Flash Evaporators Process
Multi-Stage Flash Evaporator

Stage Details
Major challenges

- Corrosion
- Biofouling
- Scale Buildup
- Production Rate
- Product Water Quality
Multi Effect Desalination Plant, Saudi Arabia
1. Steam
2. NCG Removal
3. Cooling Water Out
4. Feed and Cooling Water In
5. Distillate Out
6. Brine Out
Major challenges

- Corrosion
  - Control
  - High alloy Material
  - Chlorination

- Biofouling
  - Control
  - High alloy Material
  - Chlorination
  - Design Circulation Flow

- Scale Buildup
  - Control
  - Scale Inhibitor
  - Design Circulation Flow
  - Online chemical cleaning
Multi Effect Desalination Unit, Shell Side

Clean  Scale Buildup  Heavy scale Buildup

Multi Stage Flash Evaporators, Tube side
Multi Effect Distillation VS Multi Stage Flash Evaporators

Multi Effect Desalination

Multi Stage Flash Evaporator

Seawater

Steam

Low Temperature

Online chemical cleaning

Seawater

Steam

High Temperature

offline chemical cleaning
Thank you!
Multi Effect Distillation Process

Major challenges

- Corrosion
- Scale Deposits
Materials of Construction

• Evaporator Shells – 316 SS or 317 SS
• Tube Sheets – 254 SMO
• Tubes – Ti gr2
MED Scaling

• Outside of tube bundle
• Normally calcium carbonate with small amounts of calcium sulfate
• Follow by monitoring Gained Output Ratio (GOR)

• GOR = \frac{\text{lbs of water produced}}{\text{lbs of steam consumed}}
Evaporation Stages Material of Construction

Note: The First Flash Chambers Receiving Hot Brine @ 121 °C (250 °F) to 90 °C (200 °F) Should be Lined with Stainless Steel
Cleaning Methodology

• MSF –
  ▪ Online by ball cleaning
  ▪ Offline with sulfamic acid

• MED –
  ▪ On-line – increase antiscalant dosage and reduce load
  ▪ Offline – Sulfamic acid
  ▪ Offline – Tetra sodium EDTA