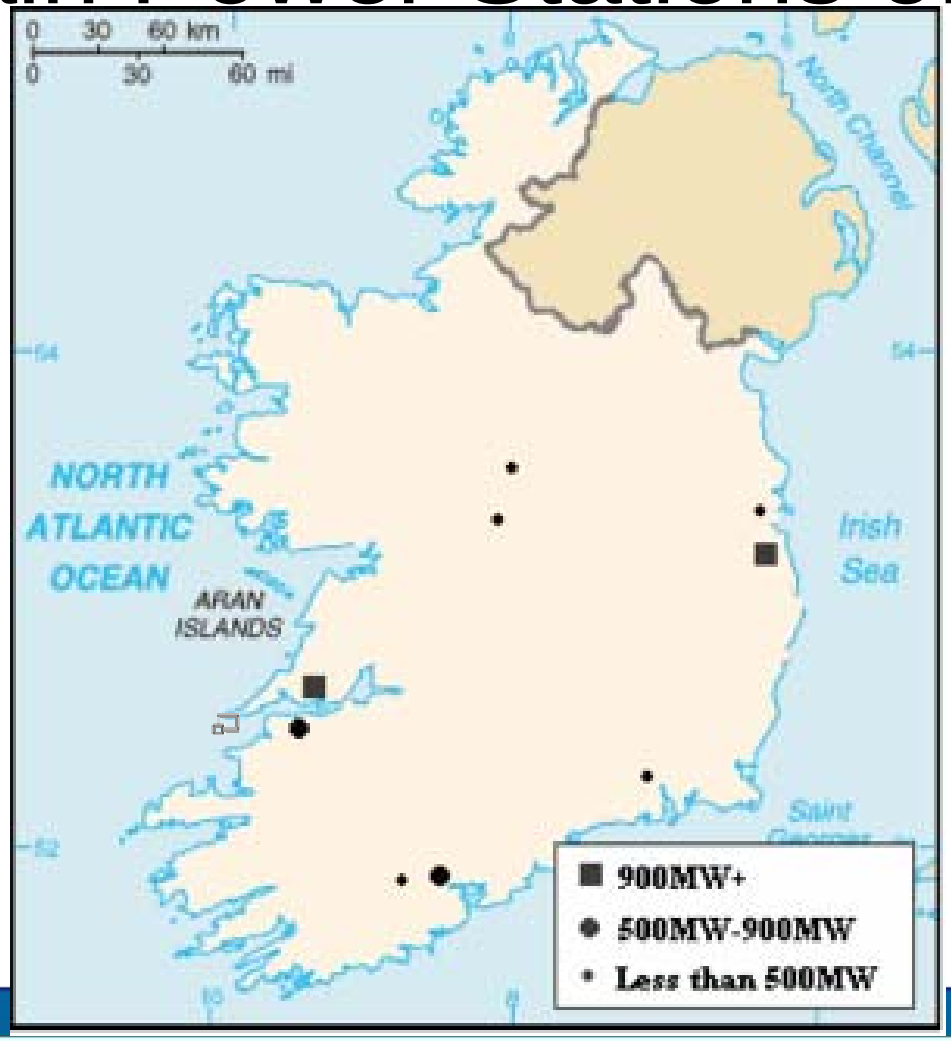
The Development and Application of Condensate Polishing in ESB

Patrick J Colman
Michael Sadler

Main Power Stations of ESB



Early Use of Condensate Polishing in ESB

- 1st Used in 1969 on 120 MW Boilers
- Design Used:
  - Precoat Candle Filters
  - Polishing Bed
  - 0.5 m Cation Resin on 1.1 m Depth of Mixed Resins,
  - i.e. A Cation Layer/Mixed Bed
- Single Vessel Regeneration Plant
- Sodium in Polished Water ~ 1 - 2 ppb

Tarbert Generating Station

Tarbert Generating Station

- Two 250 MW Boilers,
  - 538^{o}C (1000^{o}F) and 16.3 MPa (1975/76)
- Polishing Plants: 2x100%
  - Naked Mixed Beds/Unit
  - 2.4:1 Cation:Anion Resin Ratio and Linear Flow of 122 m/h
    - Problems with Resin Transfer and Regeneration
- Conventional Two Vessel Regen.
  - Plant Later Replaced By Proprietary Bottom Transfer Design and Problem Resolved
- Polished Water Cond. Now 0.056-0.059 μS/cm

Poolbeg Generating Station

Poolbeg Generating Station

- 270 MW Unit added (1978)
- Polishers Similar to Tarbert
  - 2:1 Cation:Anion Resin Mixed Beds Used with Linear Flow of 117 m/h
- Conventional Two Vessel Regen Plant
  - Top Transfer of Anion Resin
- Targets of 2 ppb Na, Cl and SO_4 Achieved

Poolbeg Generating

- Regen Method Changed, Some Years later, to Procedures Developed at Moneypoint
- Polishers Then Run in Ammonium Form
- Polished Water Qualities “Satisfactory”
    - Bed Service Runs of 55 to 65 Days the Norm

Aghada Generating Station

Aghada Generating Station

- Commissioned 1980
- 270 MW Gas Fired Once-Through Boiler
  - 538^{o}C and 16.3 MPA
  - Ti Condensers and Sea Water Cooling
- Makeup Demin Plant
  - Does Not Have Final Mixed Bed, Sodium in MU ~ 5 ppb
- Polisher Uses 2 x 100% Naked MBs
- Aghada First Station to Use Innovative, Proprietary, Design of Regeneration Plant

Aghada Generating Station

- "Conesep"
  - Design for Separating Mixed Resins Transfers Bottom Cation Resin Layer Rather than Top Anion Resin.
  - It is Aimed at Minimising Cation Resin in Anion Resin Cross Contamination So Reducing Na Contamination of Final Regenerated Cation Resin
  - First Separation Gave 0.3 to 0.6% Cation in Anion Resin. If the Anion Resin is Given a Second Separation after Regeneration Cross Contamination Reduced to 0.05 – 0.1%

Aghada Generating Station

- Trials of Bottom Transfer System at Aghada in 1982 Gave Sodium in Polished Condensate of 0.03 -0.05ppb
- Operation in Ammonium Form also Successfully Demonstrated With Sodium Levels at pH 9.6 of 0.2 -0.6 ppb
- Bottom Transfer Approach Subsequently Developed Further and Now Widely Used

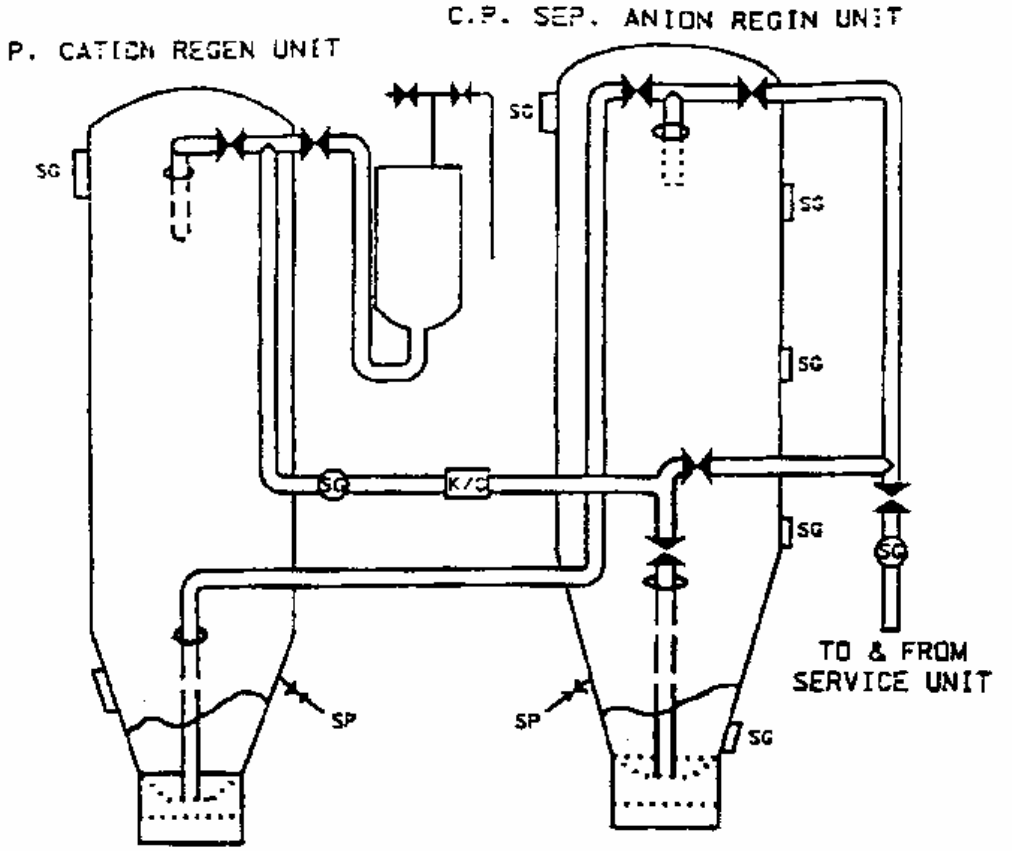
Aghada Generating Station

- In 1983 Polishers Protected Boiler
  - Small (120 ppb Na) But Difficult to Find Condenser Leak for 19 months!
- Impurities in Condensate Were (In 1997) Normally:
  - Na - 0.02-0.05 ppb
  - Cl - 0.01-0.03 ppb,
  - SO_4 - 0.03-0.1 ppb

Aghada Generating Station

- 1995
  - Trials of Experimental “Improved” Regeneration Procedures
  - Impurity Levels Were: Na - < 0.002 ppb, Cl - 0.005 ppb
- Condensate Polishers operated in the Conventional H-OH Form.
  - They Have Now Been Successfully Used for Over 28 Years Without Any Major Problems

Aghada Generating Station



K/C – CONDUCTIVITY IND. CONTROLLER
S.P. – SAMPLE POINT
S.G. – SIGHT GLASS


delta

Moneypoint Generating Station

Moneypoint Generating Station

- Moneypoint.
  - 3x305 MW, Coal Fired Drum Boilers,
  - 16.5 MPa and 540^{o}C
- Sea Water Cooling with Ti Condensers
- Condenser Hotwell Split,
  - Untreated Condensate and Polished Condensate Compartments
  - Each Unit has 3 x 57% Flow Naked Mixed Beds, Linear Velocity 103 m/h

Moneypoint Generating Station

- Two Vessel Regen.
  - System With Top Transfer of Anion Resin
- Used In Conventional Way
  - Not Suitable for Ammonium Form Operation
  - Station Needed To Operate Polishers in this Mode
  - Devised Method of Preparing Resins to High Quality Necessary for AFO Without Using a High Efficiency Separation /Regeneration System (Details in Paper)

Moneypoint Generating Station

- Have Successfully Operated Polishers in the Ammonium Form Since 1988 With Significant Operational Savings.
- Service Runs of AFO Beds as Long as 200 Days Achieved Compared with 3-5 Days Obtained Conventionally.
- Typical Levels of 0.3 ppb of Na, Cl and SO_4 in Polished Water

Moneypoint Generating Station

- Moneypoint has been successful in their use of a conventional Regeneration Plant to prepare resins for use in AFO
- Their Procedures also Used at Poolbeg
- Procedures Require Care and Attention

Lough Ree Power

West Offaly Power

LRP & WOP Power Stations

- Two Peat Burning Power Stations
- Boilers – Fluidised Bed
  - River Water Cooled.
  - WOP Very High Organic Levels in Local Surface Waters
  - LRP Well Water
- Both Equipped with Deep Bed Polishing Plants with High Efficiency Separation/Regeneration Facilities

LRP & WOP Power Stations

- Condensate Polishing Necessary:
  - Decided to Operate Using OT to Maintain Steam Conductivity Levels Below 0.15 μS/cm
  - An older Station in this Area Suffered Turbine Corrosion Claimed to be Assisted by Organic Acids in Steam

Business Issues

- Policy on Condensate Polishing
  - Sea water cooled from 1969
- Newer Plant – Heat Recovery Steam Generators
  - Ideal World – v - real world
  - Cost Implications
  - Payback
    - Income – 2 day peak outage cost ~ €1.2m

Business Issues

- Companies tend to look at the cost of plant
- Not Cost of operation
  - All Costs BTF, Availability
  - Proper cost benefit analysis needs to be considered
- Suppliers minimise costs to be competitive

Conclusions

- Polishing used Successfully Since 1969.
- Company Policy on new plant
- Plant Designs Have Evolved Based on Experience Gained
- Where Possible, Polishers are Operated in the Economical Ammonium Form
- The ESB Aware of the Need for Polishers to be Operated Competent Personnel

Conclusions

- Economic Pressures Lead to:
  - Demands for Capital Costs of Future Polishing Plants to be Lower
  - Plants should be Simpler to Operate
  - Minimal Production of Waste Requiring Discharge to Environment
- Future Needs: Cheaper! Simpler! Cleaner!

END

Thank You