Assessing and Controlling Corrosion in Air-cooled Condensers

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Ninth International Conference on Cycle Chemistry in Fossil and Combined Cycle Plants with Heat Recovery Steam Generators

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ACC at Large 3990 MW Fossil Plant

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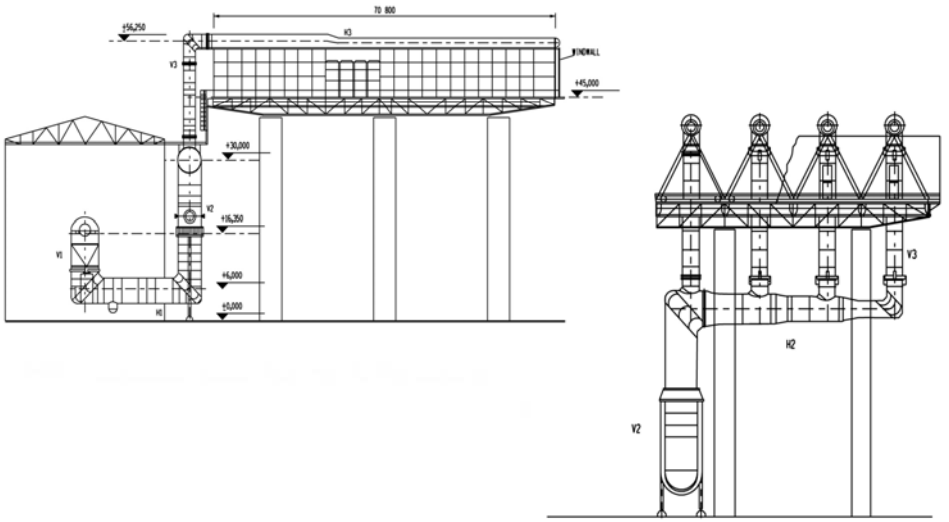
ACC Ducts are also large



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ACC Heat Exchanger Tube

(Tubes are 9.5 m (31.7 ft) and Fins are 120 and 50 mm (4.7 and 1.96 in))

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ACC at 535MW Combined Cycle Plant

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There was some uncertainty of ACC Damage

- **Where did high levels of iron in the ACC condensate actually come from?**
- **Are the various white bare metal areas in steam turbine exhaust, lower ducting and in transitions serious structural features**
- **Various appearances of A-frame tube entries**
- **What is actual corrosion process?**

The overall multi-year effort by the authors (and many others especially in Eskom) was directed at answering some of these uncertainties

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Variations of ACC Damage





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Evaluation of ACC Tubes

In an attempt to understand the corrosion process, we have looked at two samples.

We need more to paint the interfacial science.

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Inside diameter of first ACC tube analyzed

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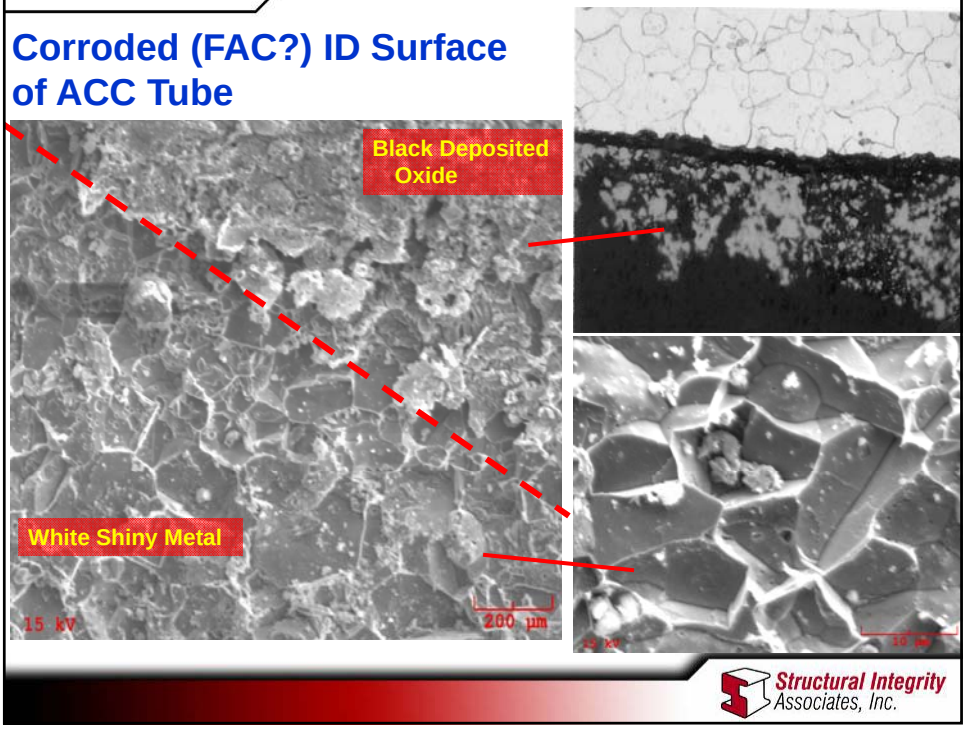
Corroded (FAC?) ID Surface of ACC Tube



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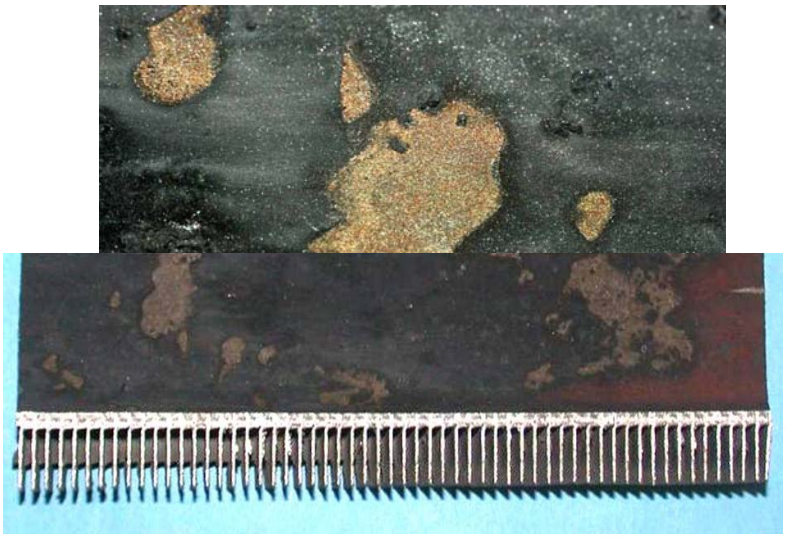
Inside diameter of second ACC tube analyzed



6 inch section of ACC tube and detail of the surface showing black deposits and white "bare" metal areas

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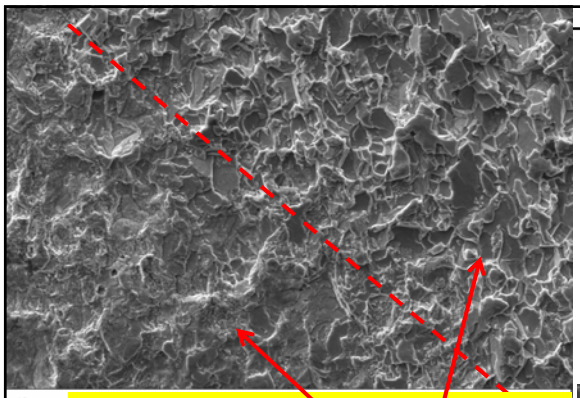
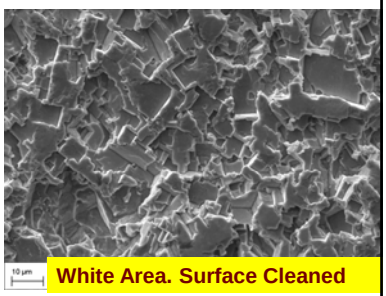
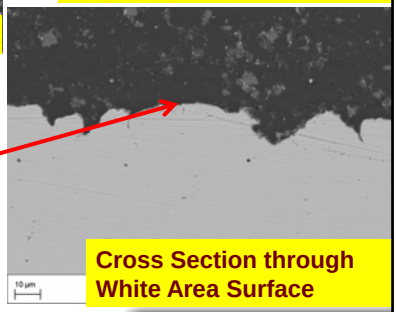




Very Thin Indigenous Magnetite on Syrface



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DHACI

(Dooley, Howell, Air-cooled Condenser, Corrosion Index)

ACC Corrosion Indices

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DHACI for Tube Entries

1. **Tube entries in relatively good shape (maybe some dark deposited areas). No corrosion/FAC.**
2. **Various black/grey deposits on tube entries as well as flash rust areas, but no white bare metal areas**
3. **Few white bare metal areas on a number of tube entries. Some black areas of deposit**
4. **Serious white bare metal areas on/at numerous tube entries. Extensive black areas of deposition adjacent to white areas**
5. **Most serious. Holes in the tubing or welding. Obvious corrosion on many tube entries**

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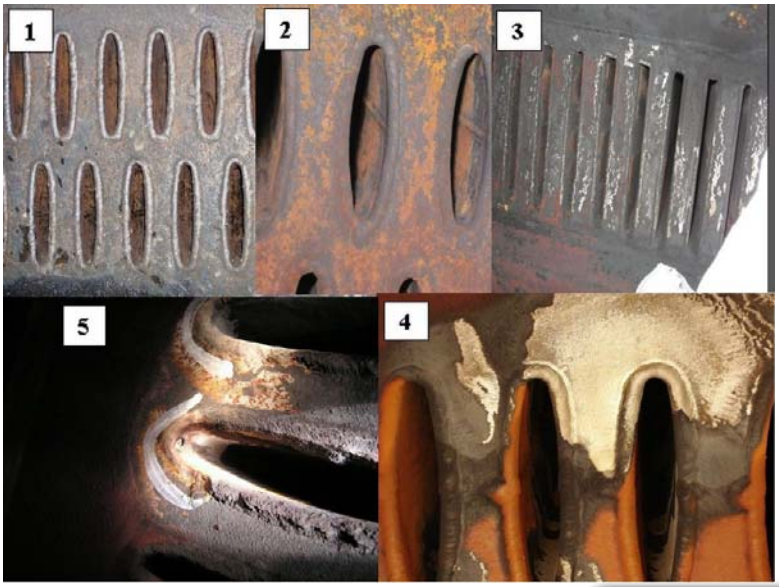
DHACI for Tube Inlets



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DHACI for Lower Ducts

A. **Ducting shows no general signs of two-phase damage and are generally grey**

B. **Minor white areas on generally grey ducting. Maybe some tiger striping with darker grey/black areas of two-phase damage**

C. **Multiple white bare metal areas in the turbine exhaust and at changes of direction (eg. at intersections of exhaust ducting to vertical riser). White areas are obvious regions of lost metal.**

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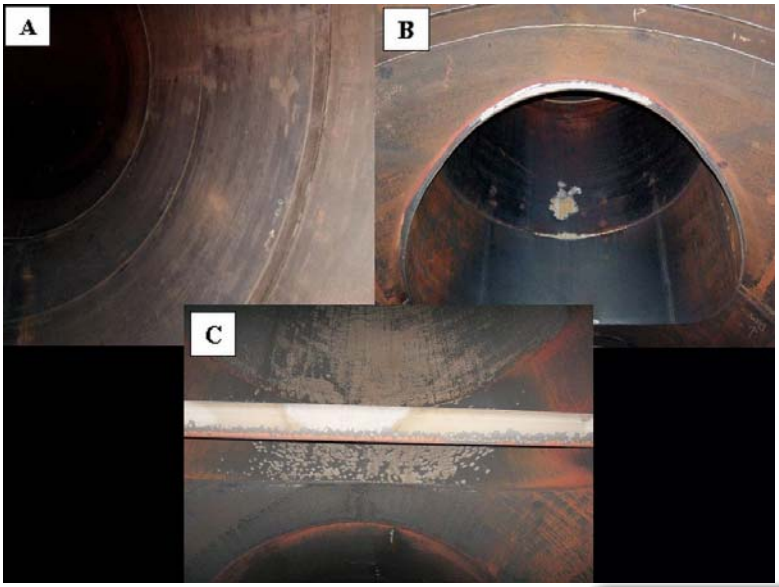
DHACI for Lower Ducts



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ACC

Chemistry Guidance

For conventional and combined cycle/HRSG plant

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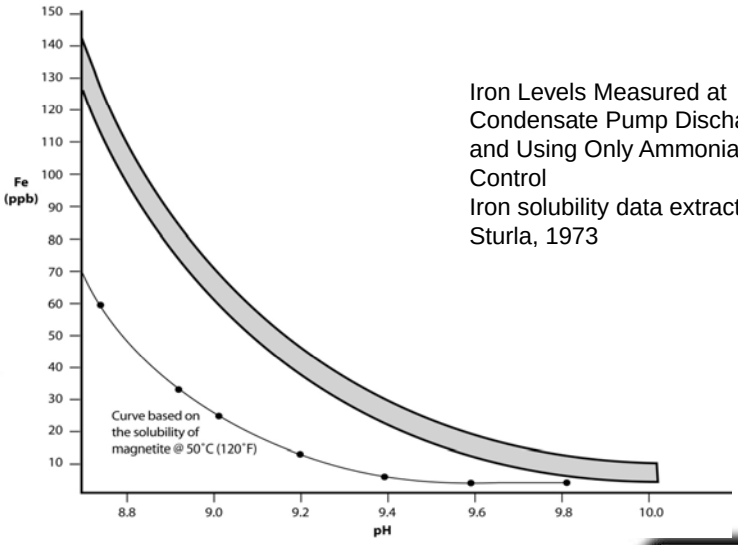
Dooley/Aspden pH Versus Iron Relationship



Iron Levels Measured at Condensate Pump Discharge and Using Only Ammonia for pH Control
Iron solubility data extracted from Sturla, 1973

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Case Study in Paper using the DHACI and Dooley/Aspden Relationship

Showing how the DHACI changes with increasing pH

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Change from pH 9.4 to 9.8

DHACI 3.
Iron in 30 – 40 ppb range

DHACI 1.
Iron in the 5 -10 ppb range

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Summary

DHACI allows semi-quantitative assessment of total ACC, but also allows changes to be monitored

Is corrosion process FAC?

Local environment has not been fully identified and further research is needed to complete the picture

- Complete definition of the environment
- Simulation of corrosion/FAC process
- Development/confirmation of solutions

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