
UN808

Reactor Chemistry and Corrosion

Course Outline

May – July 2018

INSTRUCTORS

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TOPICS COVERED:

1. Introduction

Corrosion as a Redox Reaction
Corrosion Economics
Basic Corrosion Measurements

2. Aqueous Corrosion Thermodynamics

Equilibrium Electrochemistry
Activity Coefficients
Pourbaix Diagrams

3. Aqueous Corrosion Kinetics

Current-Potential Relationship – the Butler-Volmer Equation
Evans Diagrams
Electrochemical Corrosion Measurements

4. The Eight Forms of Corrosion

General Corrosion, Galvanic Corrosion, Crevice Corrosion, Pitting, Selective Leaching, Flow-Accelerated Corrosion, Intergranular Attack, Stress Corrosion Cracking

5. Reactor Materials and Water Chemistry

CANDUs – Primary system design and materials, secondary system design and materials, auxiliary systems, reactor chemistry control regimes, activity transport in reactor circuits, decontamination
PWRs – Reactor design and materials, PWR primary system chemistry control practices
BWRs – Reactor design and materials, BWR chemistry control practices

MARKING

Assignments	50% (30% assignments of equal weighting + 20% project)
Final Exam	50%

FINAL GRADES

Final grades will be assessed according to the McMaster/UNENE standard grading scheme.

SCHEDULE

Saturday May 12, 2018 – W. Cook

09:00 – 12:00 Introduction, Corrosion Economics, Corrosion Measurements

13:00 – 16:00 Aqueous Corrosion Thermodynamics – Basic Electrochemistry, Activity Coefficients and Nernst Equation

Sunday May 13, 2018 – W. Cook

09:00 – 12:00 Pourbaix Diagrams – construction & use

13:00 – 16:00 Corrosion Kinetics – Butler-Volmer Equation, Evans Diagrams

Saturday June 2, 2018 – W. Cook

09:00 – 12:00 Eight Forms of Corrosion – General Corrosion, Galvanic Corrosion

13:00 – 16:00 Eight Forms of Corrosion – Crevice Corrosion, Pitting Corrosion, Flow-Accelerated Corrosion

Sunday June 3, 2018 – W. Cook

09:00 – 12:00 Eight Forms of Corrosion – Intergranular Corrosion, Stress Corrosion Cracking, Hydrogen Attack

Travel to CNS Conference – Saskatoon

Saturday June 23, 2018 – D. Lister

09:00 – 12:00 Configuration and Materials for CANDU systems, Chemistry Control for the CANDU Primary Heat Transport System

13:00 – 16:00 Chemistry Control for CANDU Secondary & Auxiliary Systems

Sunday June 24, 2018 – D. Lister

09:00 – 12:00 PWR Primary System Materials and
Chemistry Control, BWR System Materials
and Chemistry Control

13:00 – 16:00 Activity Transport & Decontamination of
Reactor Systems

Saturday July 14, 2018 – D. Lister / N. Popov

09:00 – 12:00 Wrap-up of uncovered materials & review

13:00 – 16:00 Student presentations on term project (15-20
minutes each)

Sunday July 15, 2018 – D. Lister / N. Popov

09:00 – 12:00 Final Examination

TEXTBOOKS (for reference)

The Essential CANDU – UNENE, 2015. Chapters 8, 14 & 15.

Handbook of Corrosion Engineering, Pierre R. Roberge, McGraw Hill, 2000.

Corrosion Engineering – 3rd or 4th Edition, Mars Fontana, McGraw Hill (out of print
although you can probably pick one up on Amazon.ca)