Economic Analysis of Nickel Release Schedules

David L. Silverstein, Ph.D., P.E.
University of Kentucky
Associate Professor
Chemical and Materials Engineering
College of Engineering Extended Campus Programs, Paducah
SilverDL@engr.uky.edu

Project Overview

- Volumetrically contaminated metal (^{99}Tc and ^{235}U)
  - 9,400 t of ingots at Paducah
  - 6,000 t scrap at Oak Ridge
  - 20,000 t scrap expected from decommissioning at Paducah, Oak Ridge, and Portsmouth
- Provide information required to maximize benefit from recovery from economic perspective

Project Goals

- Summarize the history of the issues with regard to the release of the nickel
- Report on the possible economic paths forward for the nickel at Paducah
- Analyze the technical, regulatory, and political issues associated with the nickel release
- Propose strategies for overcoming barriers to nickel release

Current Project Status

- Identify Nickel refiners and suppliers and compile historical market data (90%) (10/05 – 5/06)
- Compile historical data on nickel at PGDP (100%) (10/05-8/06)
- Analyze technical issues (90%)(10/05 – 9/06)
- Analyze regulatory issues (90%) (10/05-9/06)
- Analyze political issues (90%)(6/06 – 9/06)
- Perform economic analysis on nickel market and impact of possible release schedules (10%)(6/06 – 10/06)
- Develop case study for use in engineering courses (0%) (9/06-10/06)
- Prepare project report (10%) (9/06-10/06)

Regulatory Issues

- No guidelines from NRC
  - EU, other nations have standards for release of volumetrically contaminated scrap
  - IAEA standards
  - Health Physics Society ANSI proposed standards
  - NRC chooses to handle case-by-case
- DOE Moratorium
  - Triggered by imminent ORNL release
  - No contaminated metal releases
  - Modification to policy overdue
  - Assessment performed by DOE in 90's indicated no significant risk to consumers

Table 3—A sample comparison of published clearance standards and Class A LLRW limits for volume concentration of some radionuclides (NCRP, 2002).

Radionuclide[a] or Category	Concentration Limit for Class A LLRW ($Bq\ cm^{-3}$)[b]	Clearance Standards for Volumetric Contamination ($Bq\ cm^{-3}$)[c,d]		
		IAEA	EC	ANSI/HPS
C-14	3.0×10^4	840	280	280
C-14 in activated metal	3.0×10^5	2.4×10^3	790	790
Ni-59 in activated metal	8.1×10^6	—[e]	790	—
Nb-94 in activated metal	7.4×10^2	2.4	0.79	7.9
TC-99	1.1×10^4	840	28	280
I-129	3.0×10^2	84	2.8	28
Alpha-emitting transuranic nuclide with half-life greater than 5 y	3.7×10^3 ($Bq\ g^{-1}$)	—	—	—
Pu-241	1.3×10^5 ($Bq\ g^{-1}$)	30 ($Bq\ g^{-1}$)	10 ($Bq\ g^{-1}$)	10 ($Bq\ g^{-1}$)
Cm-242	7.4×10^5 ($Bq\ g^{-1}$)	—	3	—
Total of nuclides with less than 5 y half-life	2.6×10^7	—	—	—
H-3	1.5×10^6	8.4×10^3	2.8×10^3	2.8×10^3
Co-60	2.6×10^7	0.84	0.28	2.8
Ni-63	1.3×10^5	8.4×10^3	280	2.8×10^4
Ni-63 in activated metal	1.3×10^6	2.4×10^4	790	7.9×10^4
Sr-90	1.5×10^3	8.4	2.8	28
Cs-137	3.7×10^4	0.84	2.8	2.8

[a] Class A LLRW includes waste containing radionuclides beyond those listed here.
[b] Adopted from 10 CFR Part 61, Section 61.55.
[c] Adapted from IAEA (1996); EC (2000); ANSI/HPS (1999). (All standards are for all solid materials.)
[d] The published standards are presented in $Bg\ g^{-1}$. The values presented here are based on the assumption of the following waste densities: 7.9 $g\ cm^{-3}$ for radionuclides in activated metal (such as steel), and 2.8 $g\ cm^{-3}$ as a representative LLRW (Chen *et al.*, 1996).
[e] Dash means not available.

Chen, S., *et al*. Summary of NCRP Report No. 141: Managing Potentially Radioactive Scrap Metal, NCRP.

Political Issues

- Trade unions
- Scrap metal industry
- PACE
- Environmental
- Former DOE Facility Reuse organizations
- Public

Technical Issues

- Cleaning nickel
  - Established electrowinnowing methods adequate for overseas standards
  - Fall short of current domestic “standard”

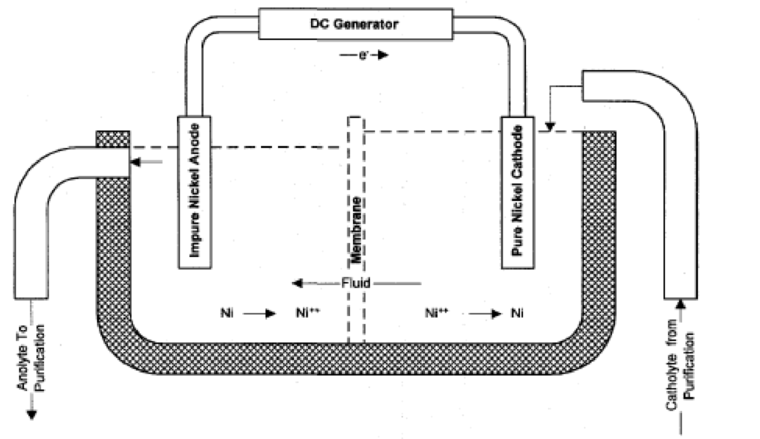

Fig. 1.1. Schematic operation of conventional nickel electrorefining cell. Modified from: Boldt 1967.

Compere, A. L., W. L. Griffith, et al. (1994). Contaminated nickel scrap processing. PBD: Dec 1994: 31 p. ; PL:.

Other options and technologies

- VLE based separations
  - CVDR, Inc. claims essentially complete separation using a proprietary CVD process
  - Other KRCEE work indicates a distillation or deposition process is feasible based on volatility differences
- Use in manufacture of waste containers
- Baseline for "clean" nickel established by KRCEE project
- Current cleanup contractor to submit cleanup plan to DOE July 31

Remaining Project Schedule

- **Complete collection of historical data for timeline (5/06-10/06)**
- **Complete regulatory, technical, and political issue analysis (9/06 – 10/06)**
- **Perform market regression analysis to assess potential impact of nickel release schedule on open market value (9/06-10/06)**
- **Prepare case study for dissemination and use in engineering economics courses (9/06-10/06)**
- **Prepare final project report (9/06-10/06)**