LABORATORY-SCALE RADIOACTIVE GLASS TESTING

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Nuclear Waste Technical Review Board
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PNL HWVP Technology Development Project
Battelle-Pacific Northwest Laboratory

Outline

- Primary Objectives of Testing
- Broad Approach to Waste Simulant and Models Validation
- Detailed Approach to Radioactive Laboratory-Scale Testing
- Waste Slurry Data Comparisons
- Glass Property Data Comparisons
- Plans for Future Work
- Conclusions

Primary Objectives of Testing

- Confirm that waste simulants accurately represent HWVP glass and process stream properties.

- Provide radioactive glass composition and properties data for use in models validation and product quality.

Waste Simulant and Glass Property Models Validation

Approach

Test Data/Property Models Correlation

Property Models

- Glass Envelope Studies
- Laboratory Simulant Slurry Studies

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HWVP Process

Laboratory-Scale
- Radioactive
- Simulant

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Bench-Scale
- Radioactive
- Simulant

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Pilot-Scale
- Simulant

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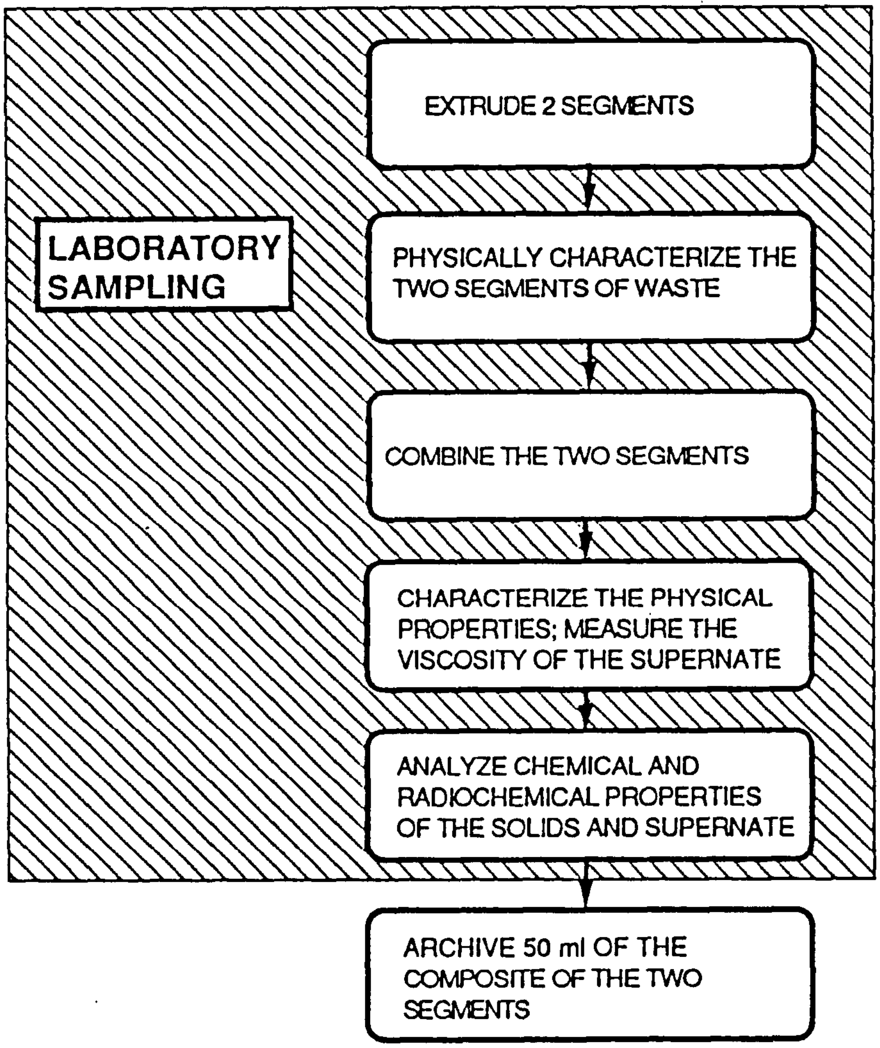
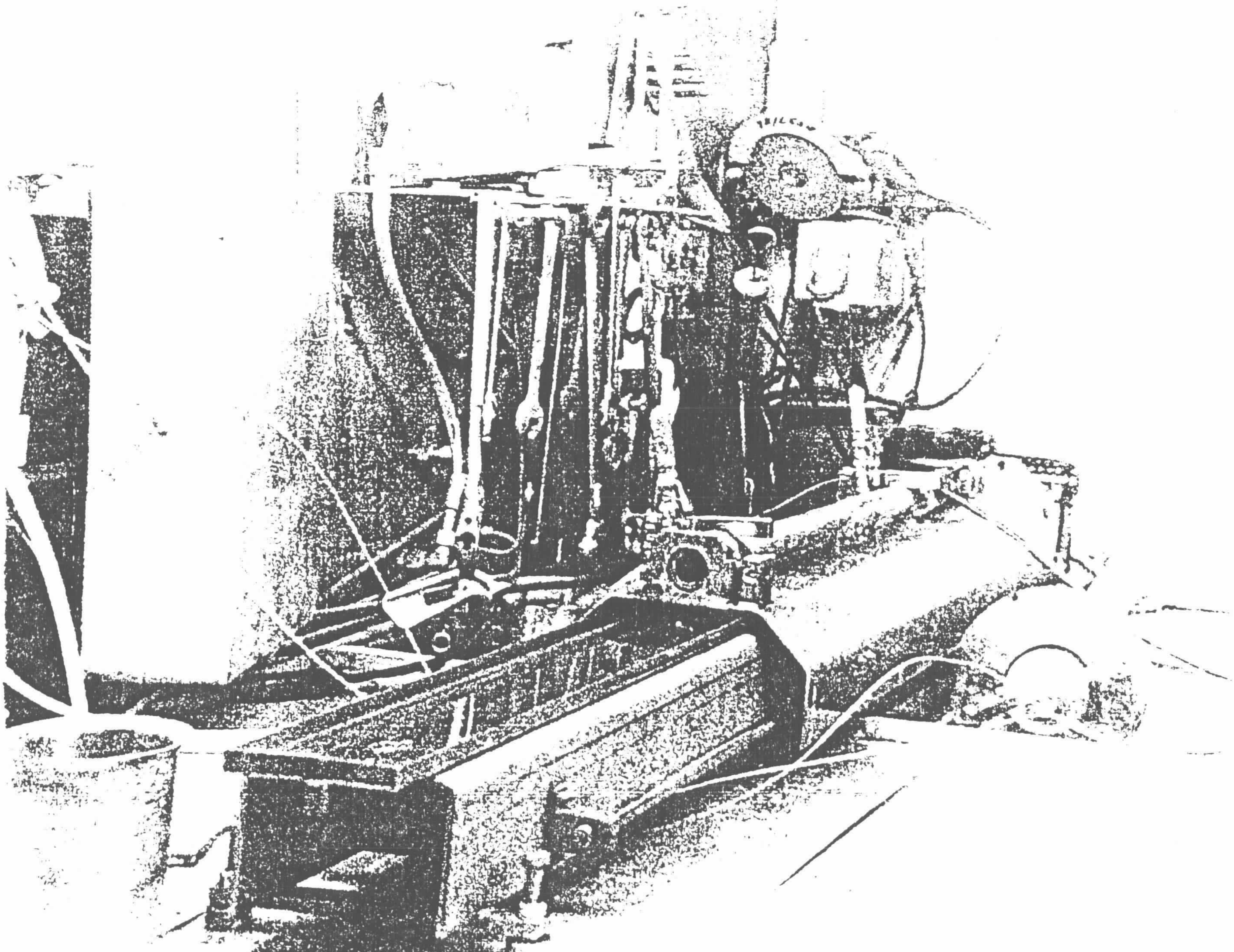
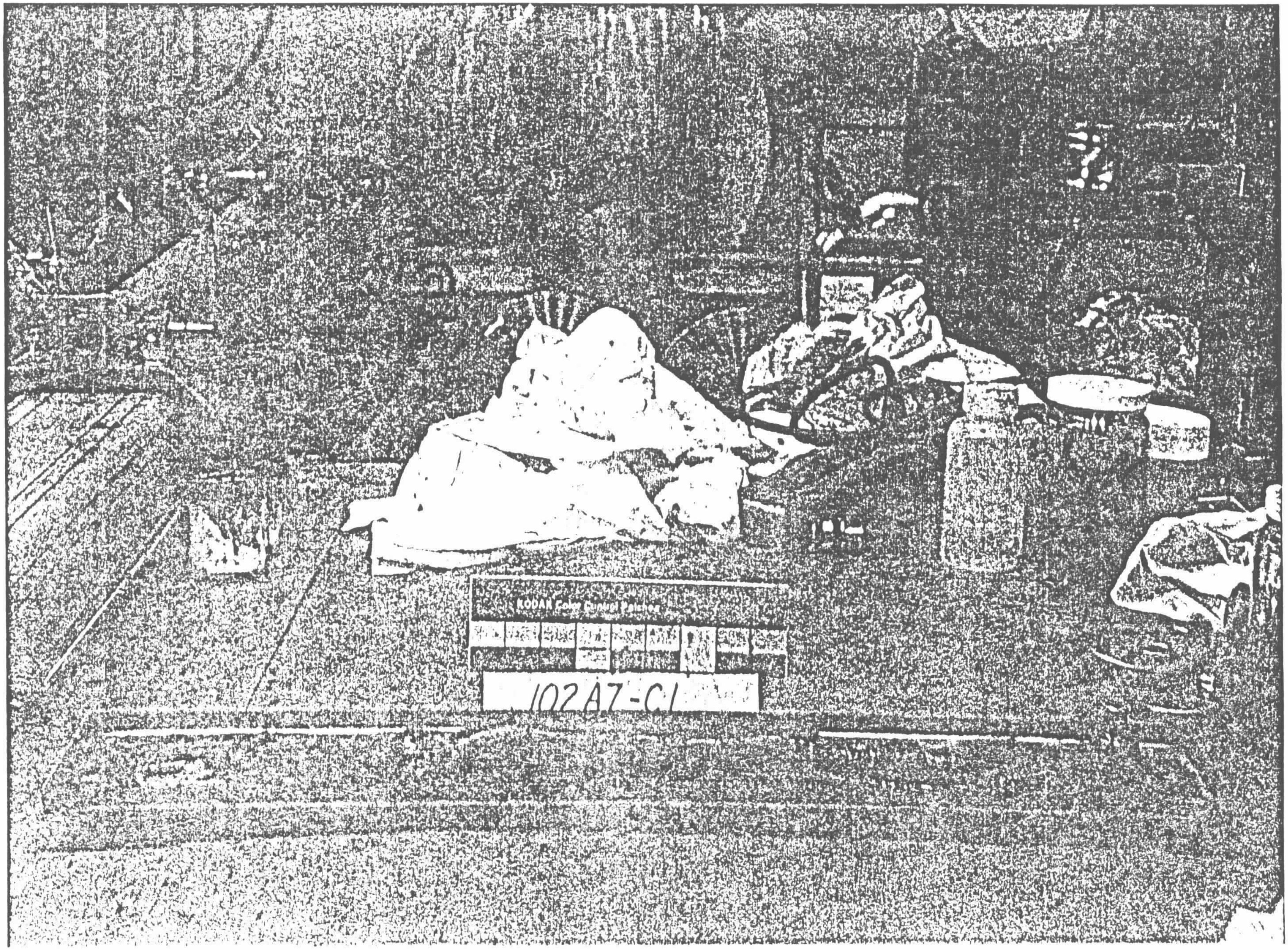
Validated Models for HWVP

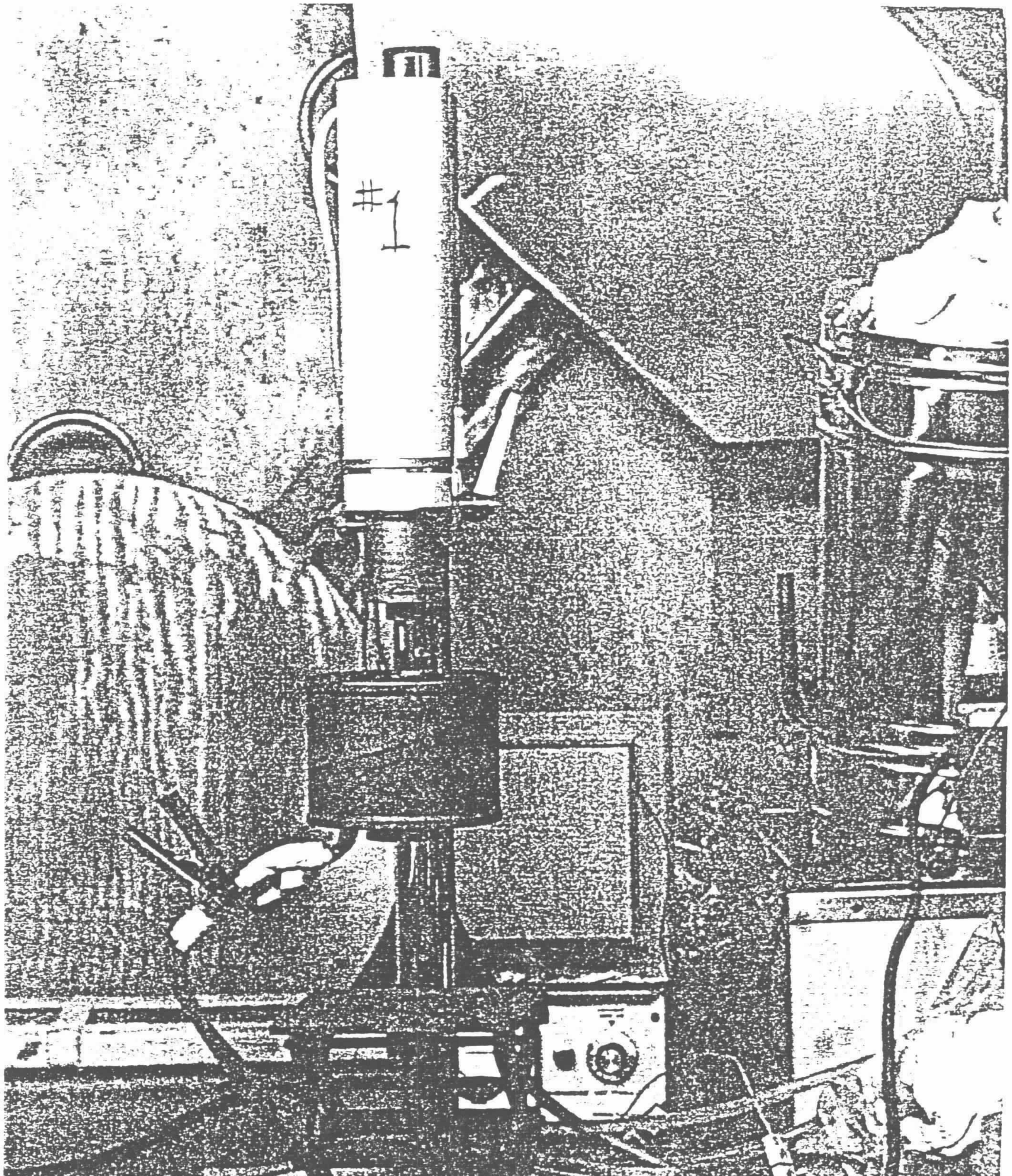
- Design
- Feed Processability
- Operations
- Permitting
- Safety
- Waste Form Qualification

CHARACTERIZATION OF RADIOACTIVE NCAW SAMPLES

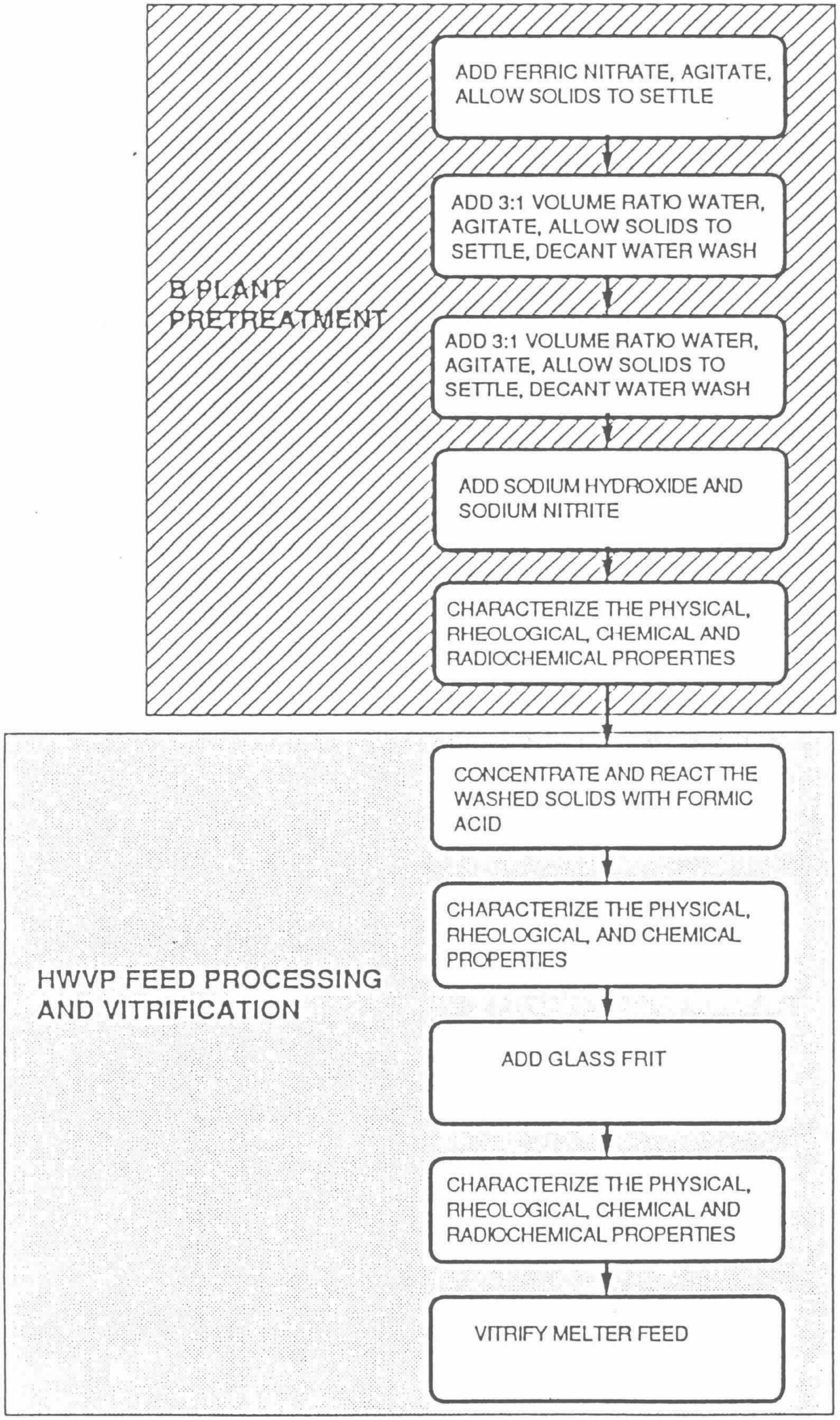


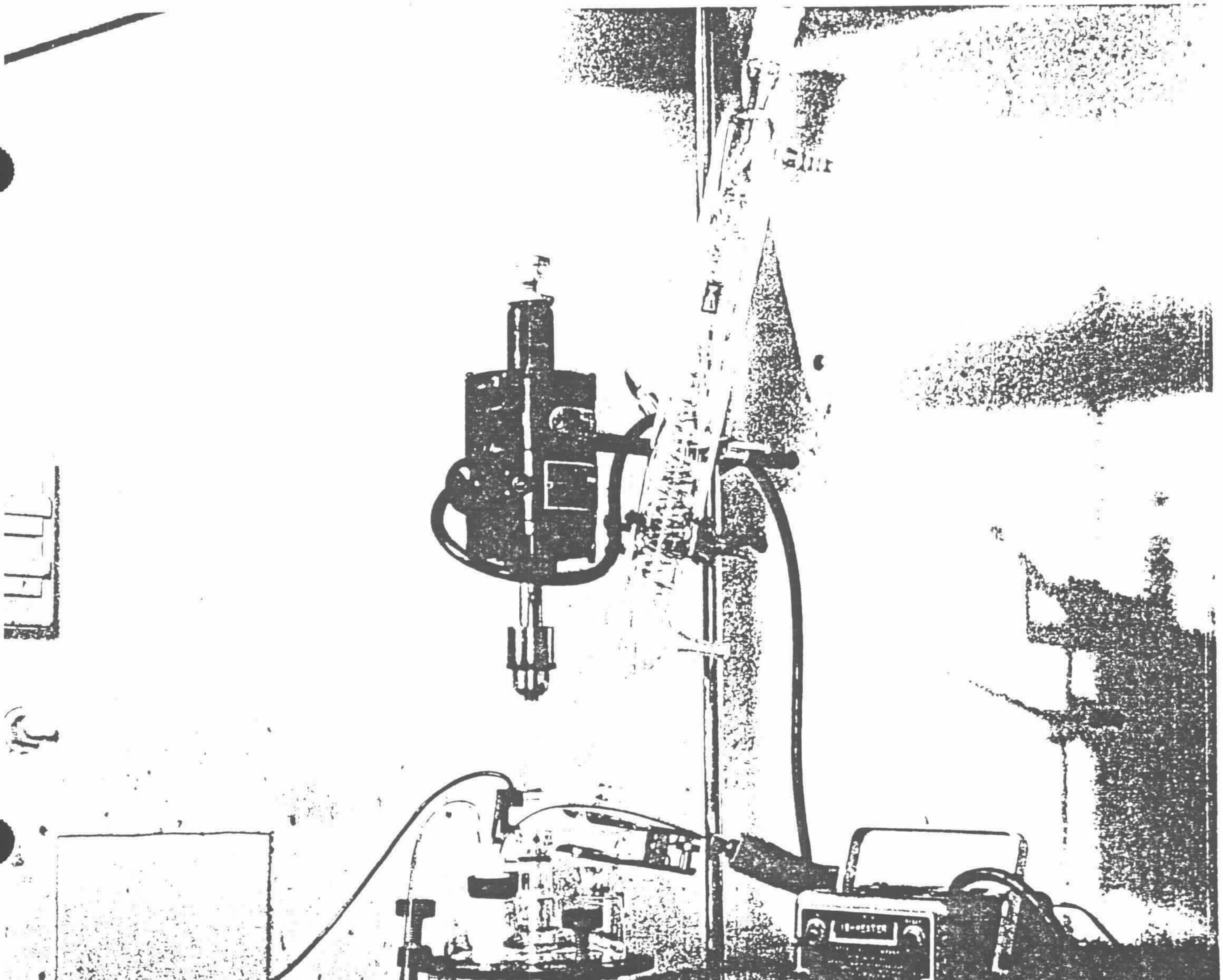



KODAK Color Control Patches
102A7-C1

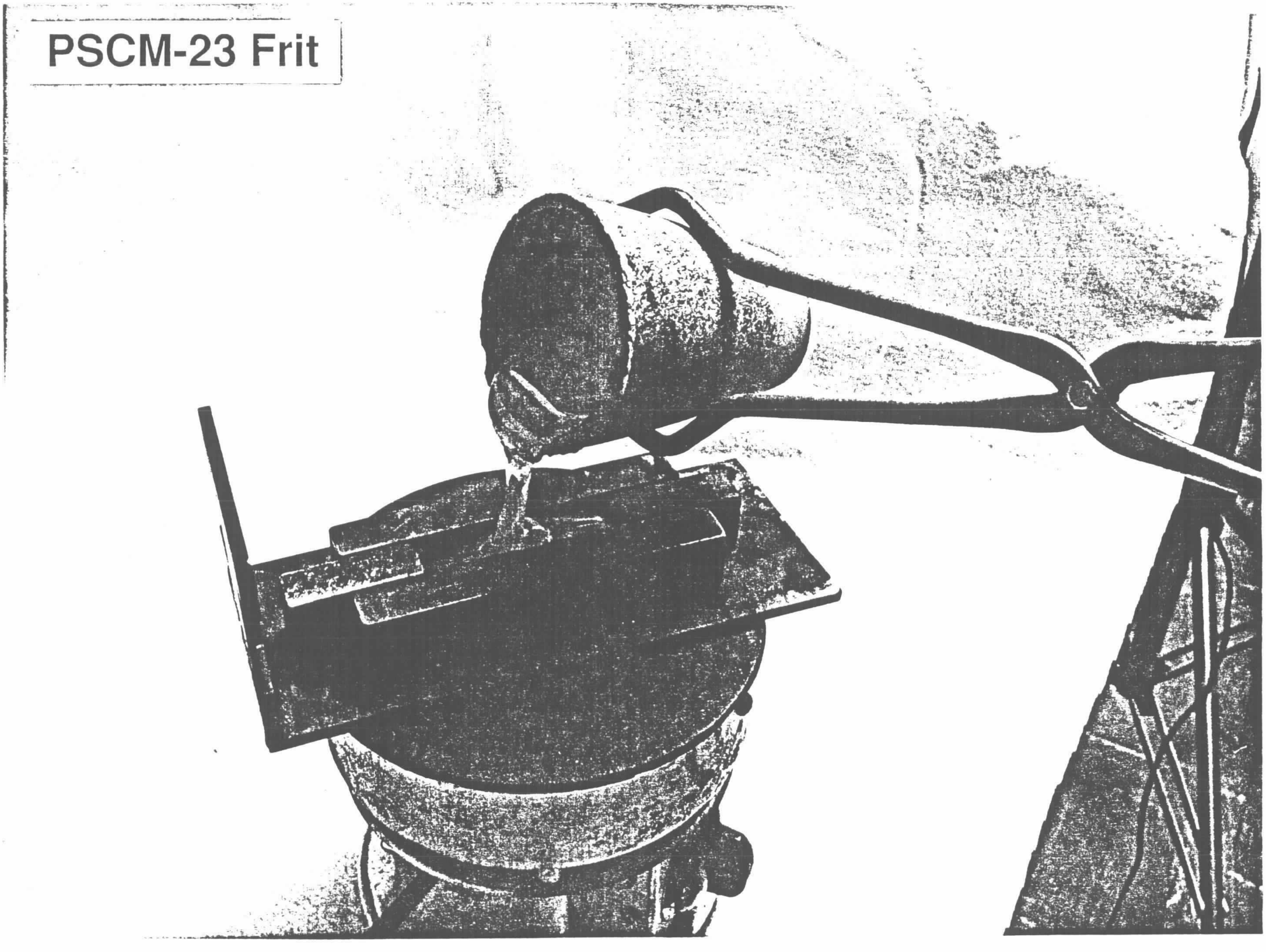

#1

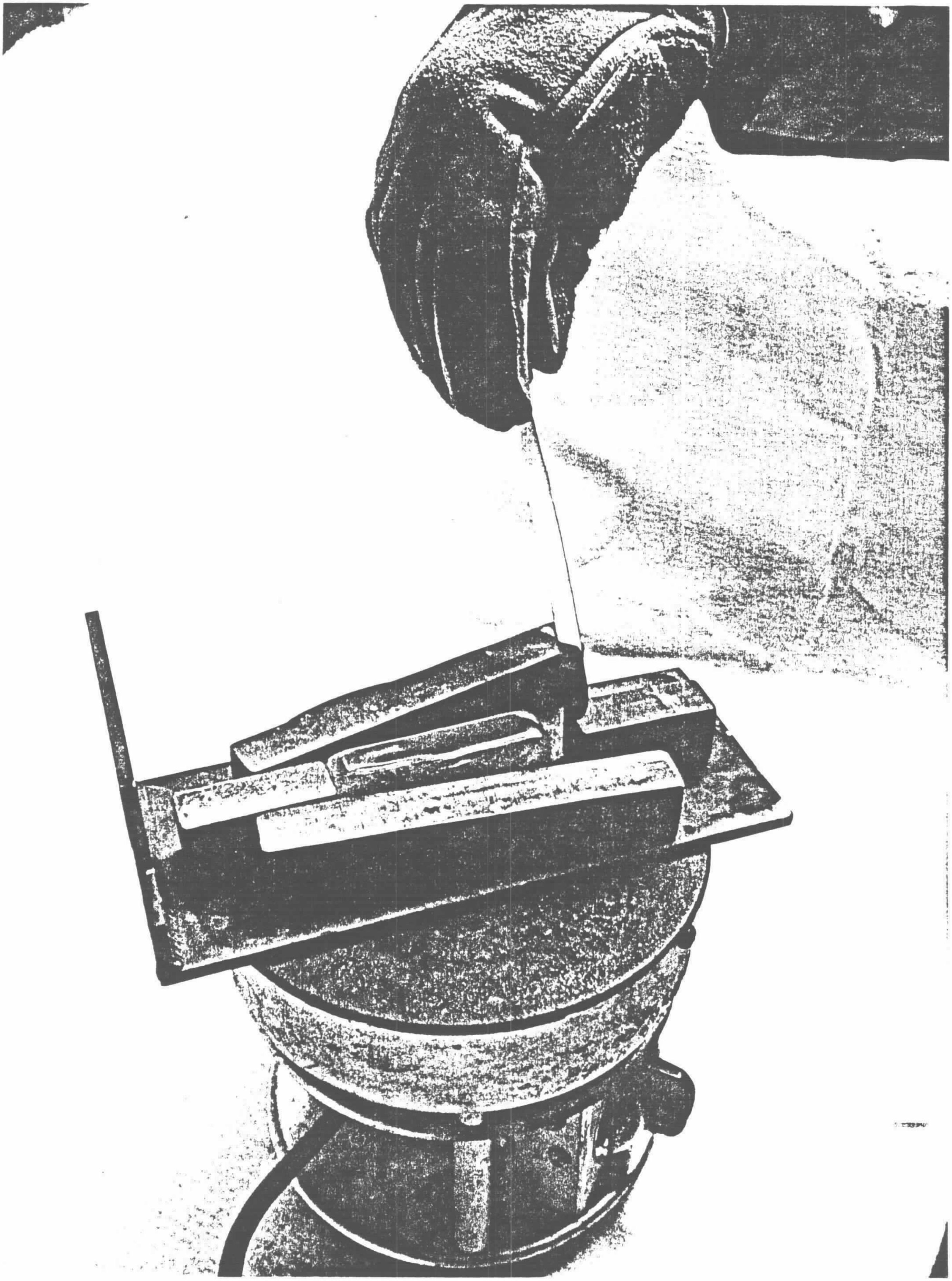
RADIOACTIVE PROCESS LABORATORY TESTING



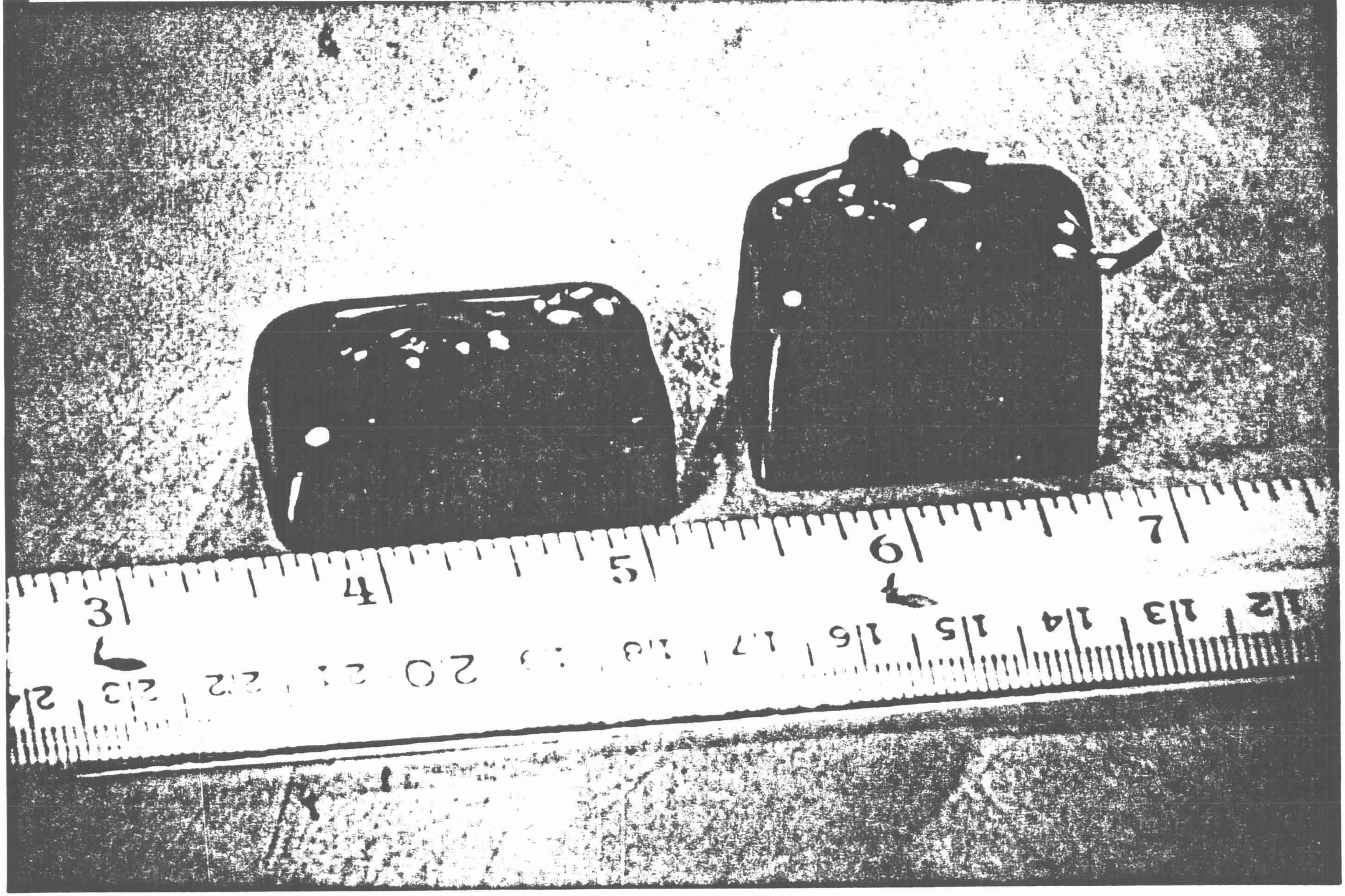


PSCM-23 Frit

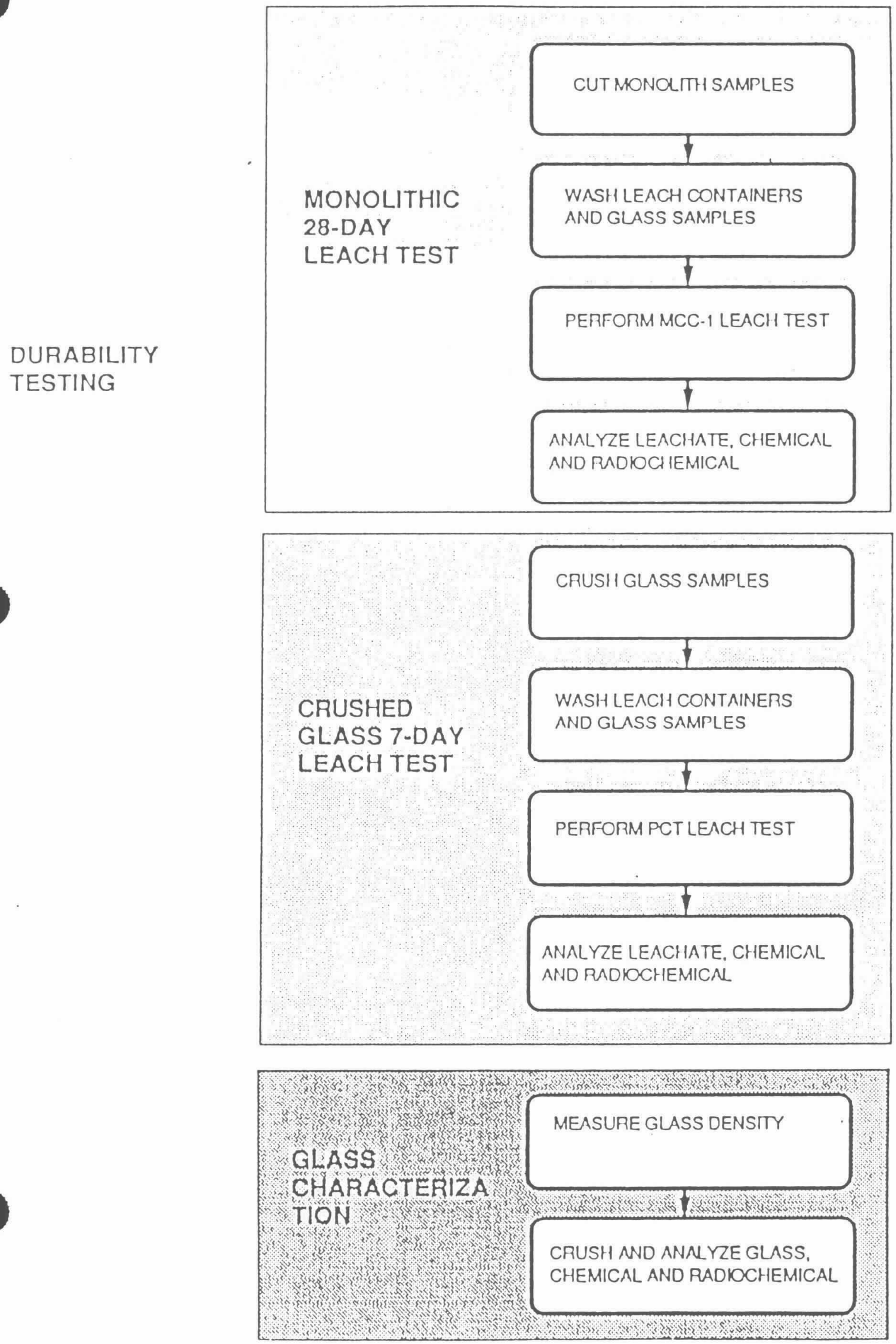




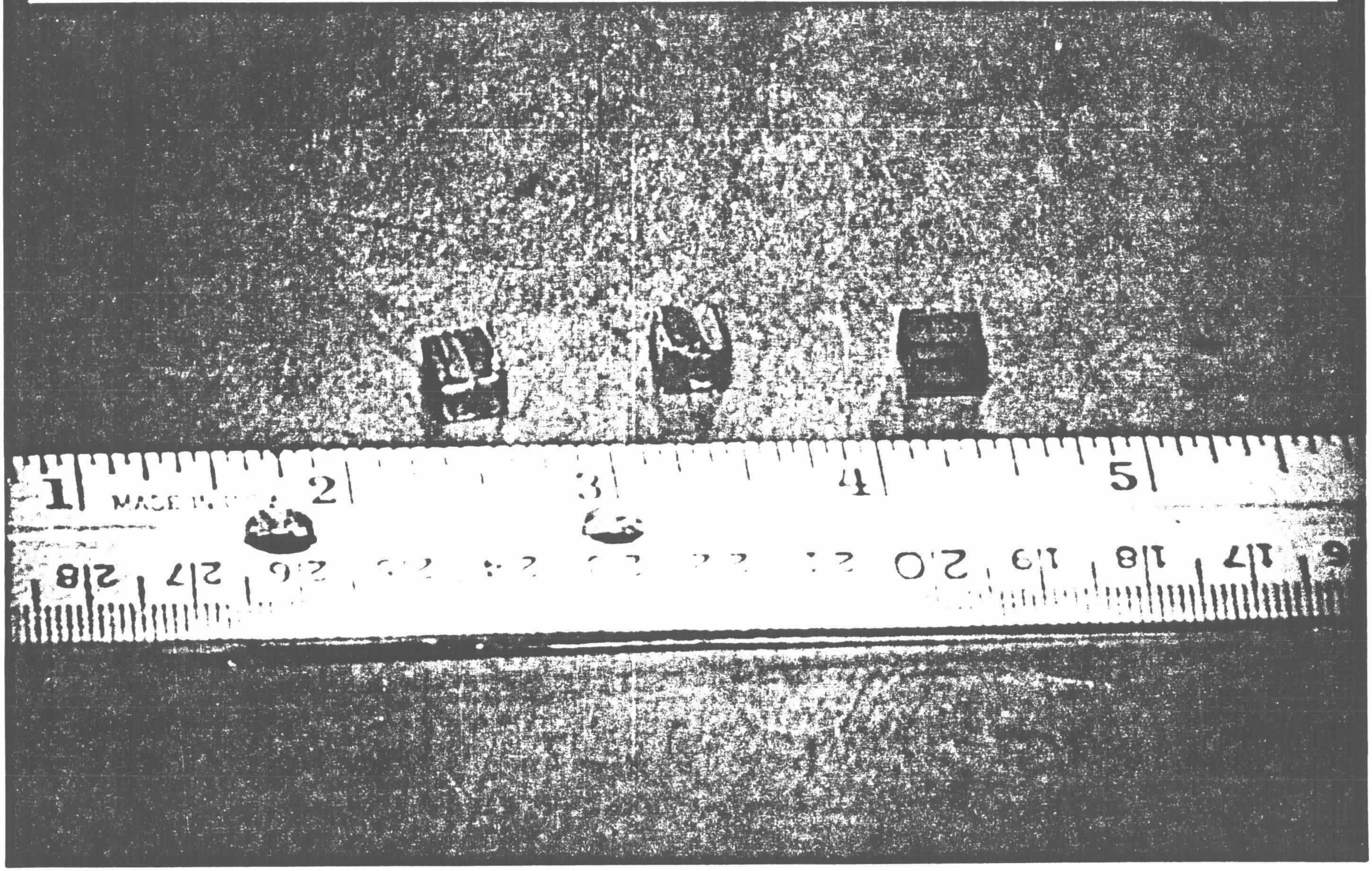
Radioactive NCAW Glass, DST 101-AZ, Core Sample #2



RADIOACTIVE PRODUCT LABORATORY TESTING



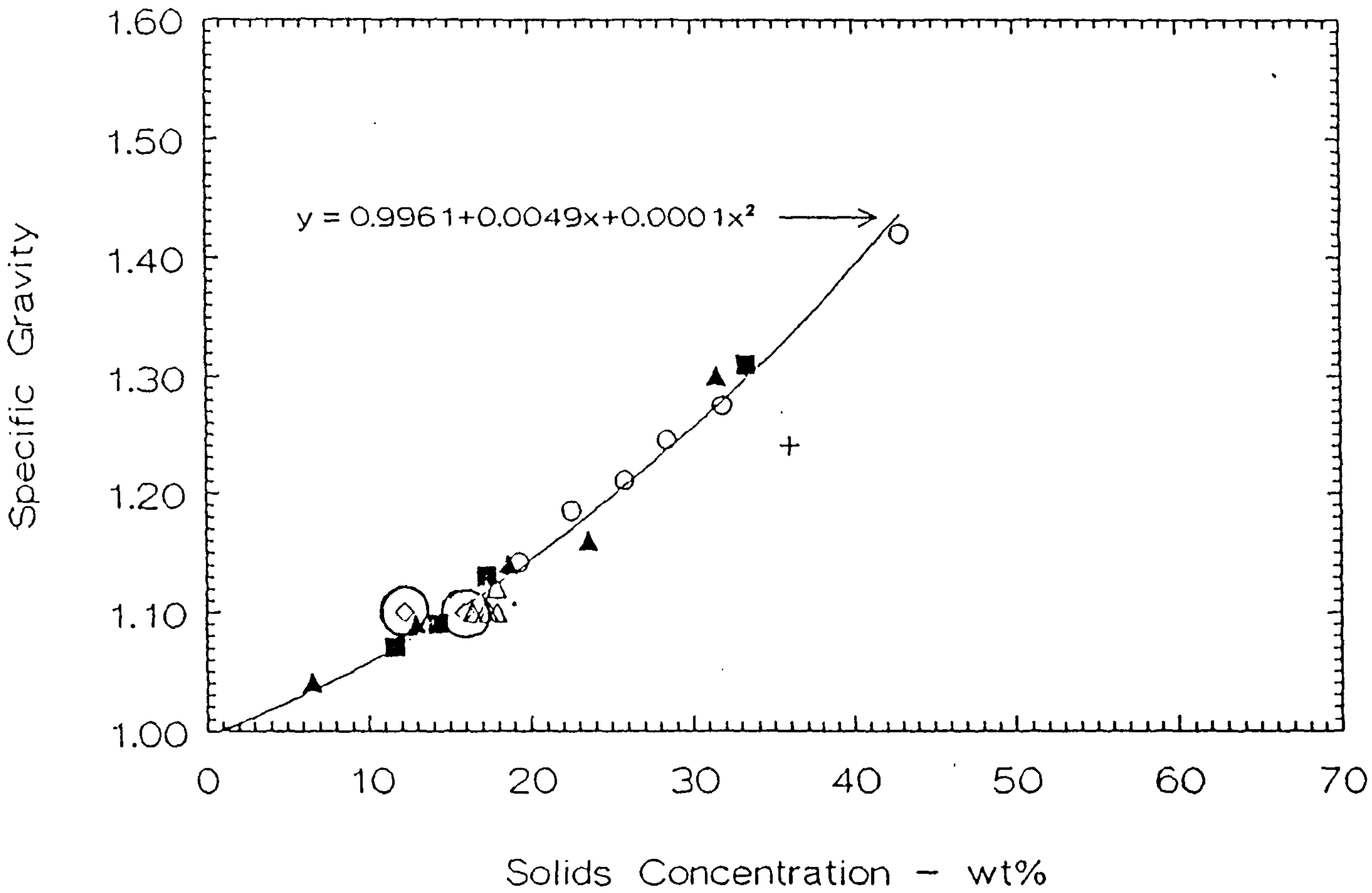
Radioactive NCAW Glass, DST 101-AZ, Core Sample #1
MCC-1 Leach Test Samples



Waste Slurry Data Comparisons

- Waste Slurries Compared (NCAW)
  - Radioactive (101-AZ, Core 1 & 2)
  - Simulant
  - Independent Simulant Data Base
- Properties Compared (abbreviated list)
  - Wt % Solids
  - Wt % Oxides
  - Density
  - Particle Size Distribution
  - Settling Behavior
  - Rheology
  - Chemical
- Based on preliminary results, behavior of simulant waste appears consistent with radioactive waste.

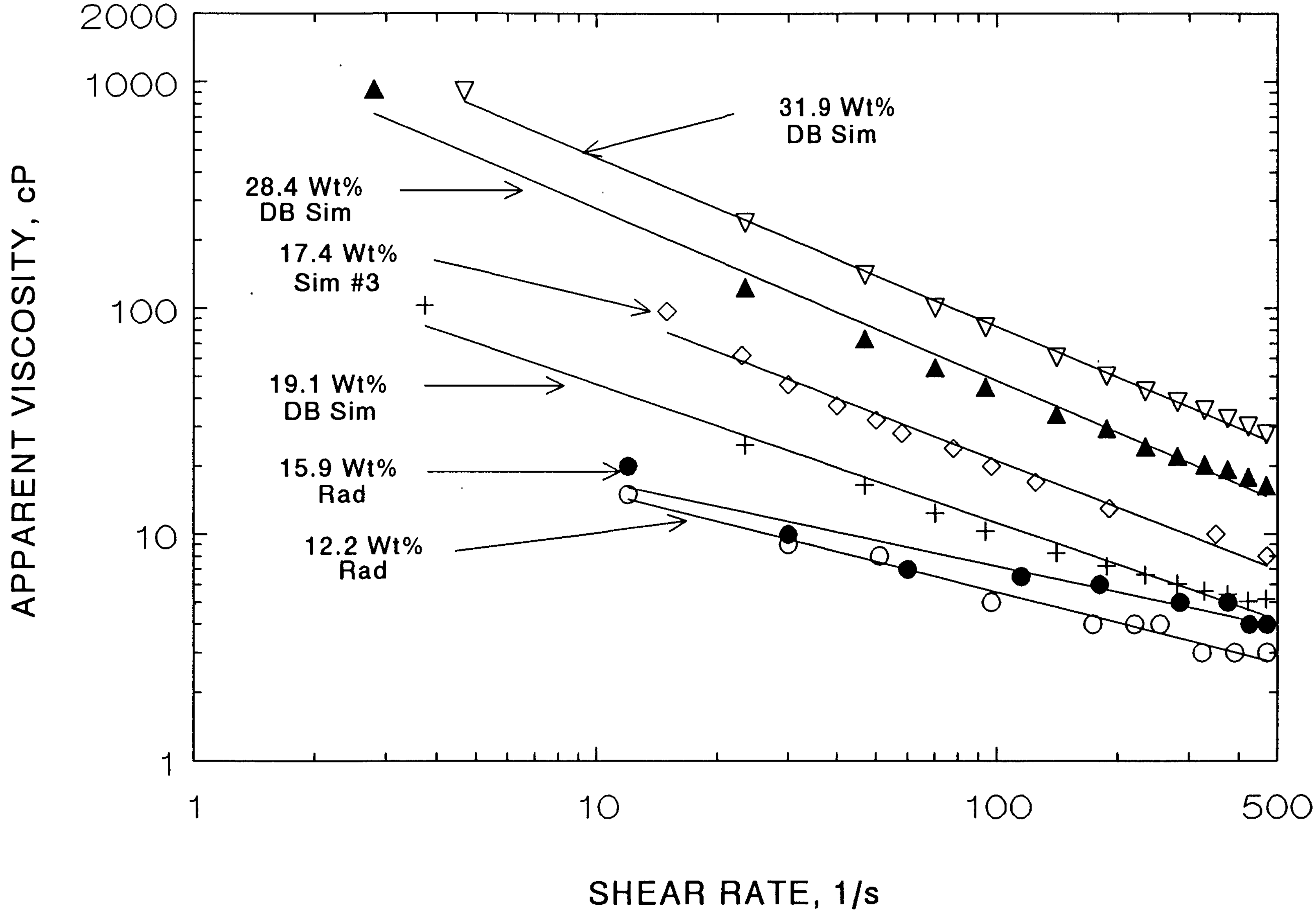
Comparison of Simulant Database to Radioactive Density Data



Formated NCAW Slurry

◎ = Actual Radioactive Waste

SYNTHETIC vs. ACTUAL FORMATED HWVP FEED APPARENT VISCOSITY AND YIELD STRESS



Glass Properties Data Comparison

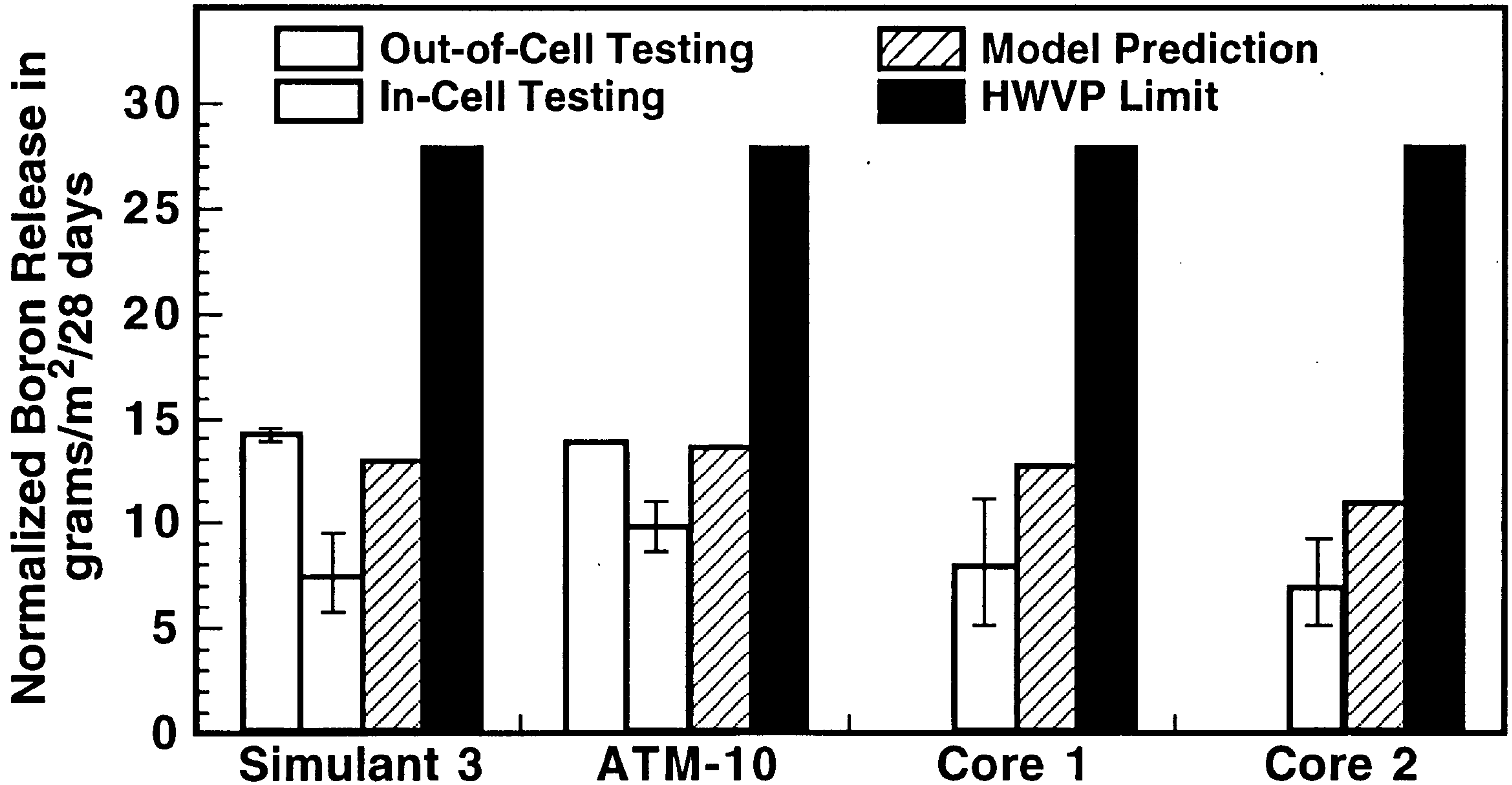
- Glass Compared
  - Radioactive (101-AZ, Core 1 & 2)
  - Simulant
  - Model

- Properties Compared
  - Durability (MCC-1 & PCT)
  - Density
  - Crystallinity & Phase Separation
  - Redox State

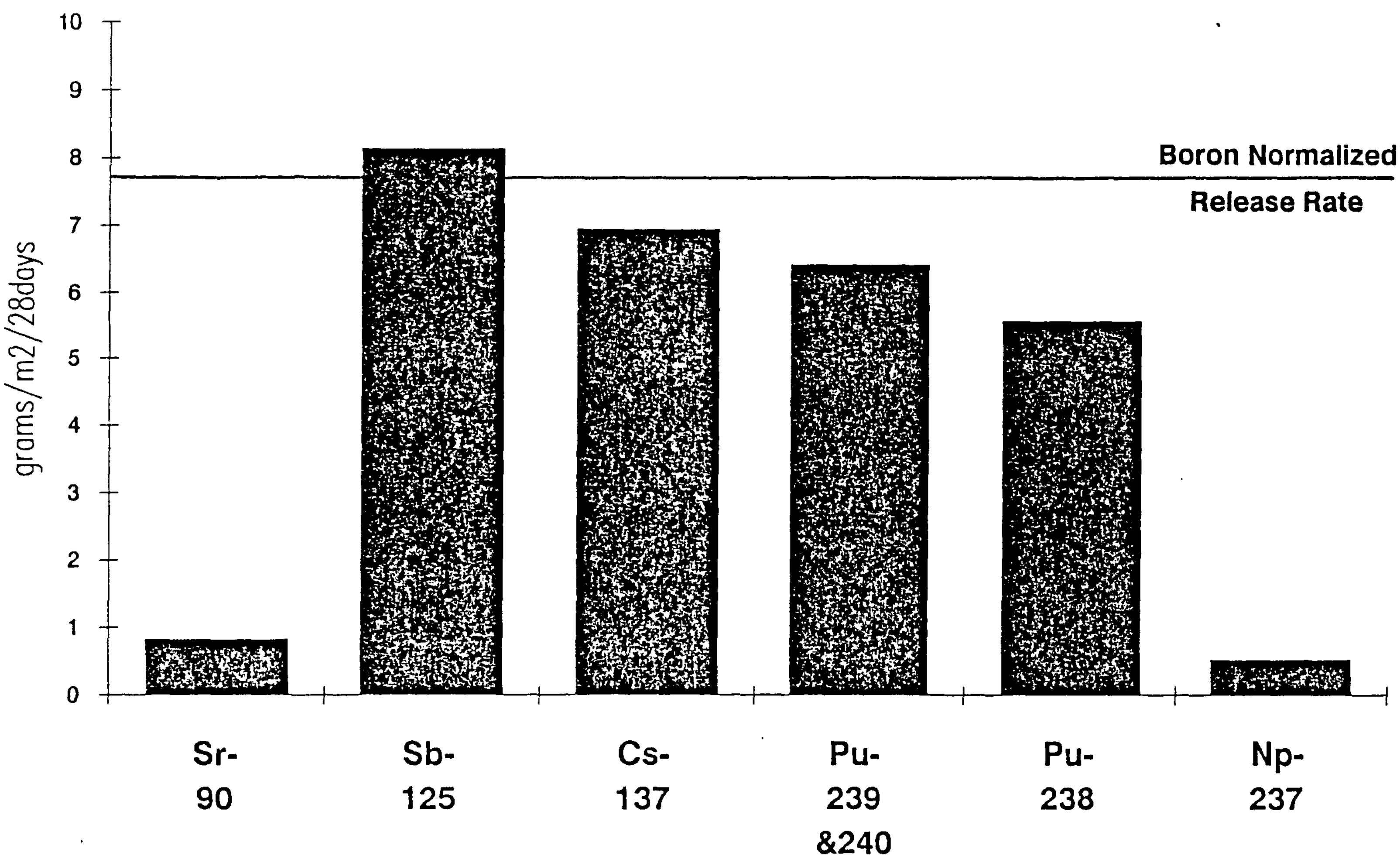
PRELIMINARY RESULTS OF 101-AZ CORE #1
ELEMENTAL ANALYSIS

	Radioactive Glass 101-AZ Core #1 (wt% oxides)	Calculated Glass Composition (wt% oxides)
Al_2O_3	5.2	5.1
B_2O_3	9.7	9.8
CaO	0.97	0.99
Fe_2O_3	10.2	11.3
Li_2O	3.6	3.5
MgO	0.77	0.77
Na_2O	9.8	10.7
SiO_2	52.0	50.3
ZrO_2	2.0	2.3
Others	5.8	5.2
Total	100.0	100.0
Waste Loading	30%	30%

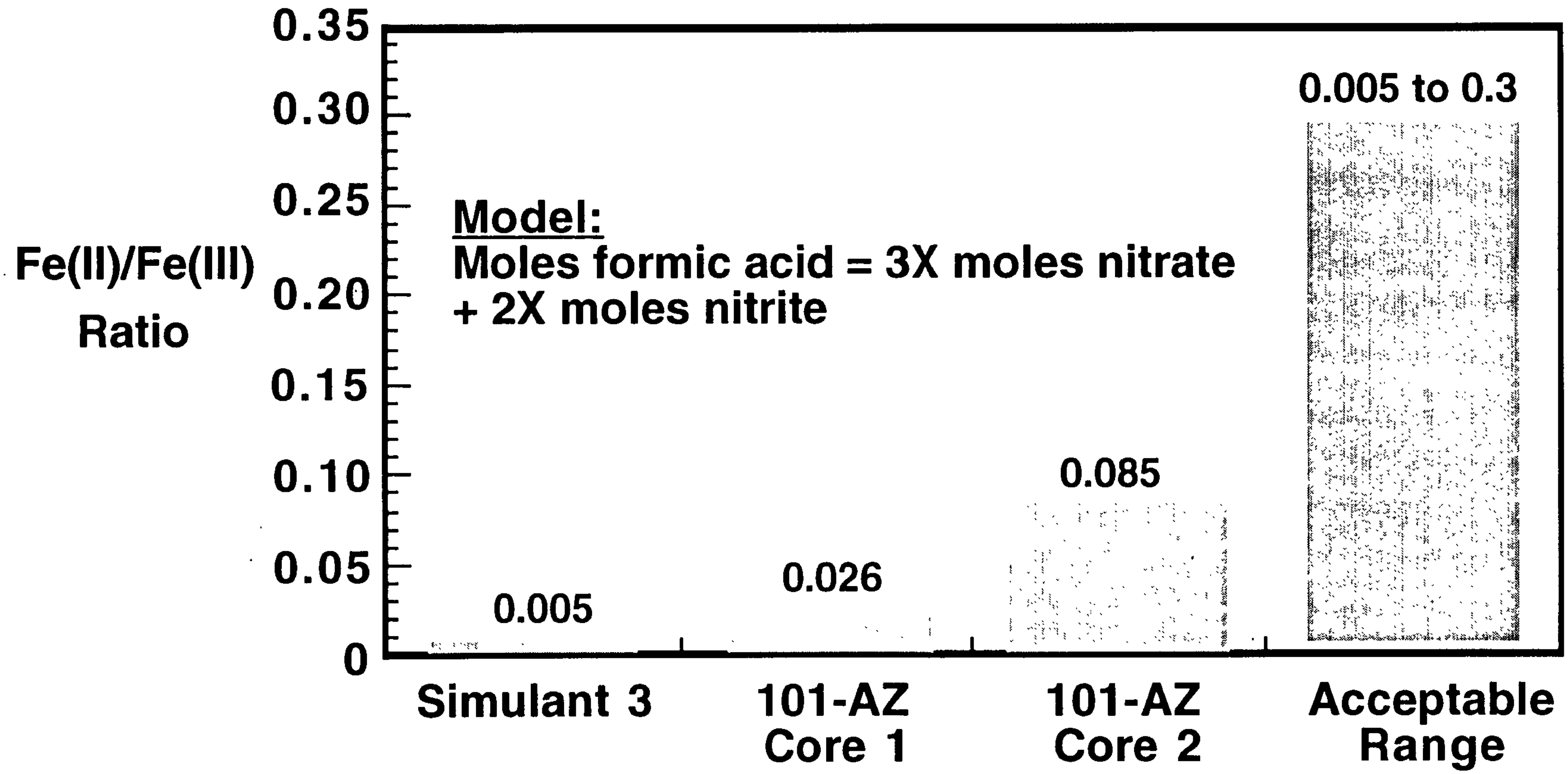
Comparison of Simulants and Model to Radioactive MCC-1 Durability



MCC-1 Normalized Release Rates of Radionuclides from 101-AZ Core 2



Comparison of Simulant and Model to Radioactive Glass Redox State



Future Plans for Core Sample Testing

- Core samples from follow-on waste types with sludge wash pretreatment will be vitrified and tested. An estimated 12-15 core samples are needed for model validation.

- Testing of the third NCAW core sample will include off-gas measurements during formating (e.g. H_2 NO, NO_2, N_2O, CO_2 C-14, I-129, volatile organics).

- Future testing may be expanded to include off-gas measurements during calcining and vitrification and viscosity and electrical conductivity measurements on molten glass.

Summary

- On a laboratory-scale actual NCAW waste can be pretreated, formated, mixed with glass frit to form a glass with a predictable chemical composition, durability, crystallinity, and redox state.

- Comparisons to preliminary radioactive data indicate that simulants and models are representative of actual radioactive process slurries and glass.

- Additional data/evaluation and model development are needed for improved model validation.