Treatment of Radioactive Liquid Waste by the Forced-Air Exhaust System - 15190

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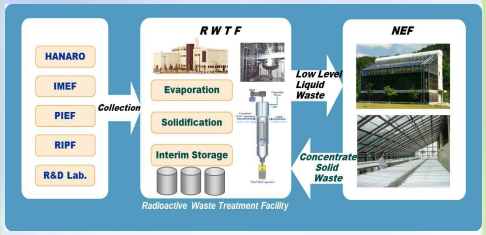
INTRODUCTION

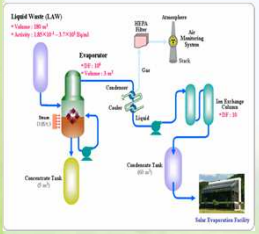
Concept of Zero Release at KAERI



ZERO RELEASE

- No discharge of Radioactive liquid waste from KAERI to environment
- Natural Evaporation Facility
  - Pure water component (RWTF) ➡ Natural Evaporation Facility Radioactivity component / Concentrate ➡ solid waste RWTF

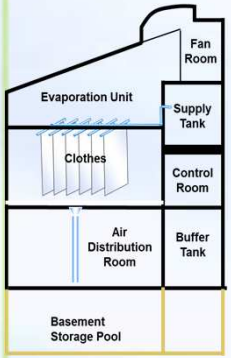
Evaporation Process



- Consist of Process : Evaporator / Storage tank / Transfer unit / Cooling unit / Ventilation unit / Radiation monitoring system
- Equipment type : semi-batch forced circulation
- Evaporation capacity : 1.0 m³/hr
- Decontamination factor : 100,000
- Heat source : Steam (105 C°)

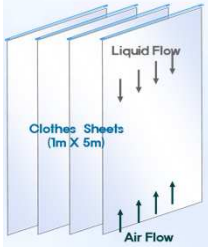
LIQUID EVAPORATION PROCESS (Air Exhaust System)

Description of Facility



- System principle : Evaporation process by solar energy and air stream
- Facility structure : concrete building
  - four floors and one underground
  - 24m(L), 12m(W), 15m(H)
- Area of facility : 1,148 m²
- Maximum evaporation capacity : 1.2 m³ /hr
- Consist of Facility
  - Evaporation equipment
  - Storage unit
  - Transfer unit
  - Ventilation unit
  - Radiation monitoring system.

Evaporation Theory



dE = K * (Ps - Pw) / H * dt

dE : Amount of evaporation (unit time, unit area)

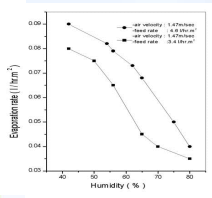
Ps : Saturation vapor pressure of air

Pw : Vapor pressure of air

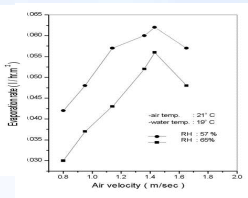
K : Constant (Air factor)

H : Atmosphere pressure

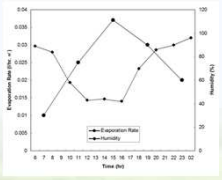
Experiment Result



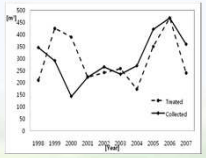
Effect of Humidity on Evaporation Rate



Effect of Air Velocity on Evaporation Rate



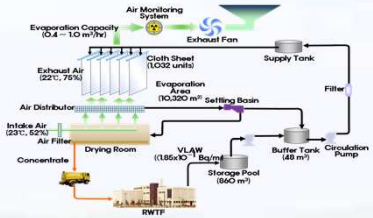
Transition of Evaporation Rate for 24 Hours



Operation results of the NEF for 10 years

- Evaporation Factor
  - Relative humidity
  - Air Temperature, Air flow rate
  - Liquid Temperature, Liquid flow rate
  - Possible Operation : May - October

Natural Evaporation Process



Dimension

- structure : concrete building
  - four floors and one underground
- DIMENSION
  - 24m(L), 12m(W), 15m(H)
- Area of facility : 1,148 m²
- Maximum evaporation capacity : 1.0 m3 /hr

Description of NEF

- `85. 1~`86. 1: Basic Research
- `87. 1~`88.10: Design & construction
  `89.1~`90. 8 : Performance Test
- `90.8 ~ : Operation

- The liquid waste transfer into the buffer tank and supply tank.
- Liquid flow down and recycle.
- The solid waste and concentrate back to the RWTF.

CONSIST OF EQUIPMENT

- Evaporation Module : 1,032 EA, 1M * 5.4M
- Evaporation Material : Cloth Sheet
  - Synthetic Textile : cotton(35%), polyester (65%)
- Exhaust Fan : Axial Type, 1,600 m³/min, 10ea
- Cartridge Water Filter : 50 micro, 50ea
- Storage Tank : 860m³ (23m * 3.7m *3.4m * 3ea]
- Radioactivity Measurement System

CONCLUSIONS

- Relative Humidity : 40% - 80%
- Liquid Waste Flux : 3.4 l/hr m² - 4.6l/hr m²
- Air Temperature : over 10 °C
- Air Velocity : 0.6 - 1.47 m/sec
- Evaporation Rate : 0.4 - 1.0 m³/hr