CALCINER PILOT PLANT WASTE MINIMIZATION PRACTICES AT THE ICPP

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ABSTRACT

Calciner pilot plants at the Idaho Chemical Processing Plant are used to develop new chemical flowsheets for the calcination of highly radioactive liquid waste at the New Waste Calcining Facility and to produce experimental calcine. Non-radioactive solid and liquid waste is generated by the Calciner Pilot Plants during their operation. Solid and liquid waste volume data between 1980 - 1990 has been gathered and evaluated. This data shows that solid hazardous waste generation volumes have been reduced by 66% and liquid waste (hazardous and non-hazardous) generation volumes have been reduced by 40% over this time period. Waste minimization practices are found to be the cause of the solid and liquid waste volume reductions.

INTRODUCTION

The Idaho Chemical Processing Plant, ICPP, is operated by Westinghouse Idaho Nuclear Company, Inc., WINCO. The mission of the ICPP is to recover uranium from spent reactor fuel by dissolving the fuel in a highly acidic solution then extracting the uranium from the dissolved products. The highly radioactive liquid waste containing the dissolved products is converted into a solid radioactive waste by a process known as calcination.

Calcination of the highly radioactive liquid waste into a solid radioactive waste occurs in a fluidized bed that is operated at high temperatures. The liquid waste, once in contact with the hot fluidized bed, is instantaneously converted to a solid waste form known as calcine. This process is currently performed at the ICPP in the New Waste Calcining Facility, NWCF.

Calcination of the highly radioactive liquid waste is desirable because the solid calcine is less corrosive than the original liquid waste and the solid calcine consumes approximately one-seventh of the volume of liquid waste calcined. Therefore, the solid calcine is more environmentally safe for storage and a 7 to 1 waste reduction is accomplished.(1)

Calciner pilot plants are used at the ICPP to develop flowsheets that maximize the reduction of liquid waste at the NWCF and to produce experimental calcine. The experimental calcine is used to develop new waste forms, such as glass and ceramic pellets, to further reduce the waste volume consumed by the calcine solids. WINCO currently owns and operates three calciner pilot plants; the 10-cm, 15-cm and 30-cm Diameter Calciner Pilot Plants. These pilot plants are used to scale-up a successful flowsheet prior to that flowsheet being used by the NWCF.

The ICPP has calcined four million gallons of highly radioactive liquid waste since 1963. The ICPP was the first plant in the world to use calcination for converting highly radioactive liquid waste into a radioactive solid waste.(1)

SOLID HAZARDOUS WASTE

Solid waste generated during calciner pilot plant tests was considered hazardous due the possibility that it was contaminated with calcine that contains cadmium and/or hexavalent chromium. This solid hazardous waste was being generated at a rate of 3 bags/40 hours of calciner pilot plant operation. However, after March of 1990 only solid waste visibly containing hazardous material (calcine solids and/or hazardous liquid) was disposed of as hazardous waste. Other solid waste was disposed of as nonhazardous after verification through random sampling. Therefore, a reduction, shown in Fig. 1, has been seen in the number of solid hazardous waste bags being produced; 3 bags/40 hours to 1 bag/40 hours.(2) However, it is emphasized that a reduction in the total number of hazardous waste bags produced is due to the reduction in calciner pilot plant operations where as the reduction in the rate is a result of the above segregation.

The calcine produced by the calciner pilot plants is considered hazardous because it contains cadmium and possibly hexavalent chromium. All of the calcine produced by the pilot plants is used in new waste form experimentation and as starting bed for the NWCF. A 100 % waste reduction is accomplished with the pilot plant calcine.

LIQUID HAZARDOUS WASTE

As shown in Fig. 2, the liquid waste generation rate for the 10-cm Calciner Pilot Plant averaged 8.2 liters/hour between 1980 and 1984. A waste generation rate reduction to 3.2 liters/hour was noticed between 1988 and 1990.(2) Reasons for this reduction are: 1) the leftover feed from calciner test runs being reduced by minimizing excess feed for each run, 2) the steam condensate and cooling water from the calcine feed mix tanks being diverted from a hazardous waste stream to the non-hazardous service waste and, 3) the aluminum nitrate scrub solution from the Cold Feed Makeup Dissolution Facility (used to make Zirconyl Feed for the calciner pilot plants) being recycled back to the feed to complex the hydrofluoric acid. The volume of hazardous waste generated from the steam condensate and cooling water was approximately 200 liters/batch. Table I shows the hazardous waste steam condensate and cooling water waste volumes. Recycling the aluminum nitrate scrub to the Zirconyl feed reduced the waste generated by an estimated 50 liters per batch.

TABLE I

Mix Tank Stream and Cooling Water Waste

Year	10-cm	30-cm
1980	784 liters	0 liters
1981	1152 "	8640 "
1982	784 "	0 "
1983	2156 "	392 "
1984	1960 "	15360 "
1985	0 "	8640 "
1988	0 "	0 "
1989	0 "	0 "
1990	0 "	0 "

A waste generation rate reduction was also found for the 30-cm Calciner Pilot Plant. Figure 3 shows the liquid hazardous waste generation rate averaged 85.5 liters/hour for the years 1981, 83, 84, and 85, but during 1988 the waste generation rate was reduced to 58 liters/hour.(2) Reasons for this reduction are analogous to the 10-cm waste generation rate reduction, however the rate for the 30-cm Calciner Pilot Plant was further reduced by recycling the acid scrub back to the feed tank.

Generic waste minimization practices have reduced the total waste generated by the calciner pilot plants. The decrease in operating frequency, as seen in Table II, and duration of calciner test runs (because of permit restrictions) are the biggest reasons for seeing a waste reduction. Smaller reductions in waste generation have been accomplished by using concentrated scrub solutions and by using the 10-cm Calciner Pilot Plant instead of the 30-cm Calciner Pilot Plant. Being more selective in the type of experimental test performed (i.e. more lab work) has also contributed to waste minimization.

TABLE II

Annual Number of Calciner Pilot Plant Runs

Year	# of 10-cm Runs	# of 30-cm Runs
1980	4	0
1981	6	4
1982	4	0
1983	11	2
1984	10	8
1985	0	4
1986	0	0
1987	0	0
1988	4	2
1989	2	0
1990	3	0

FUTURE CALCINER PILOT PLANT WASTE REDUCTIONS

Future waste minimization practices for the calciners are: 1) to further reduce the volume of leftover feed by replacing the current feed makeup/mixing tanks with new tanks capable of mixing smaller volumes, and 2) use solutions generated by other pilot plants as feed for the calciner pilot plants.

CONCLUSION

Waste reduction has been accomplished in the calciner pilot plants. Even though the greatest reduction has occurred because of the decrease in the operating frequency and duration of the plants operation, waste minimization practices have contributed to a significant reduction in solid and liquid waste generation rates. Calciner pilot plant waste volume data collected for the past ten years shows that the volume of solid hazardous waste generated has been reduced by 66 % and liquid waste generation rates have been reduced by 40%.

REFERENCES

1. Pamphlet, WBE-011(5-87), "New Waste Calcining Facility", Westinghouse Idaho Nuclear Company, Inc.
2. Personal communication with B. J. Newby.

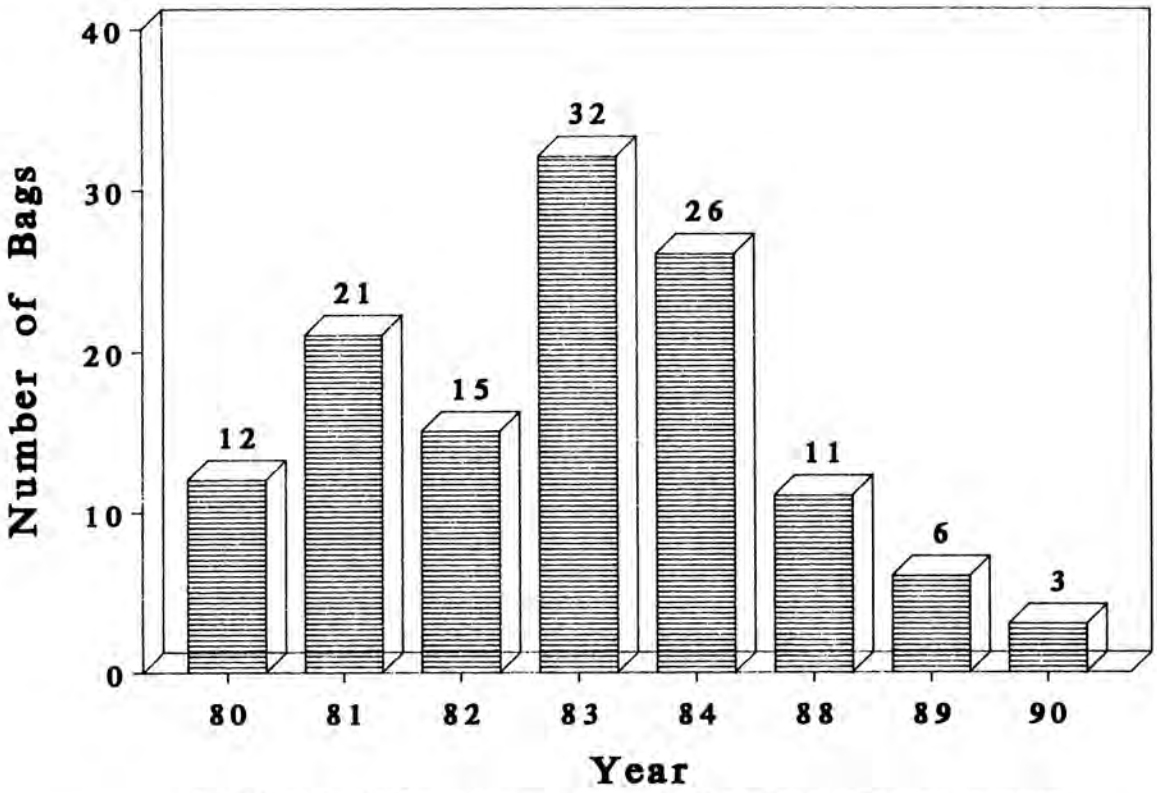

Fig. 1. Bags of solid hazardous waste generated by calciner pilot plant operation.

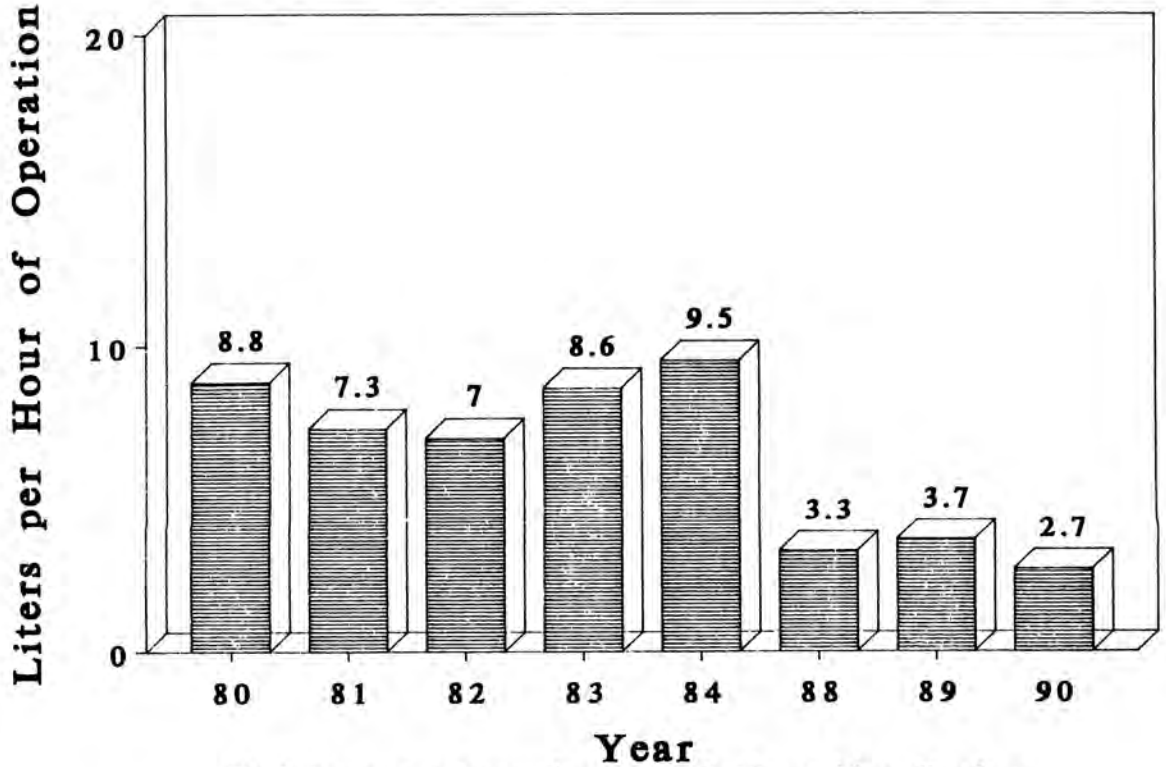

Fig. 2. Average waste generation rates for the 10-cm calciner pilot plant.

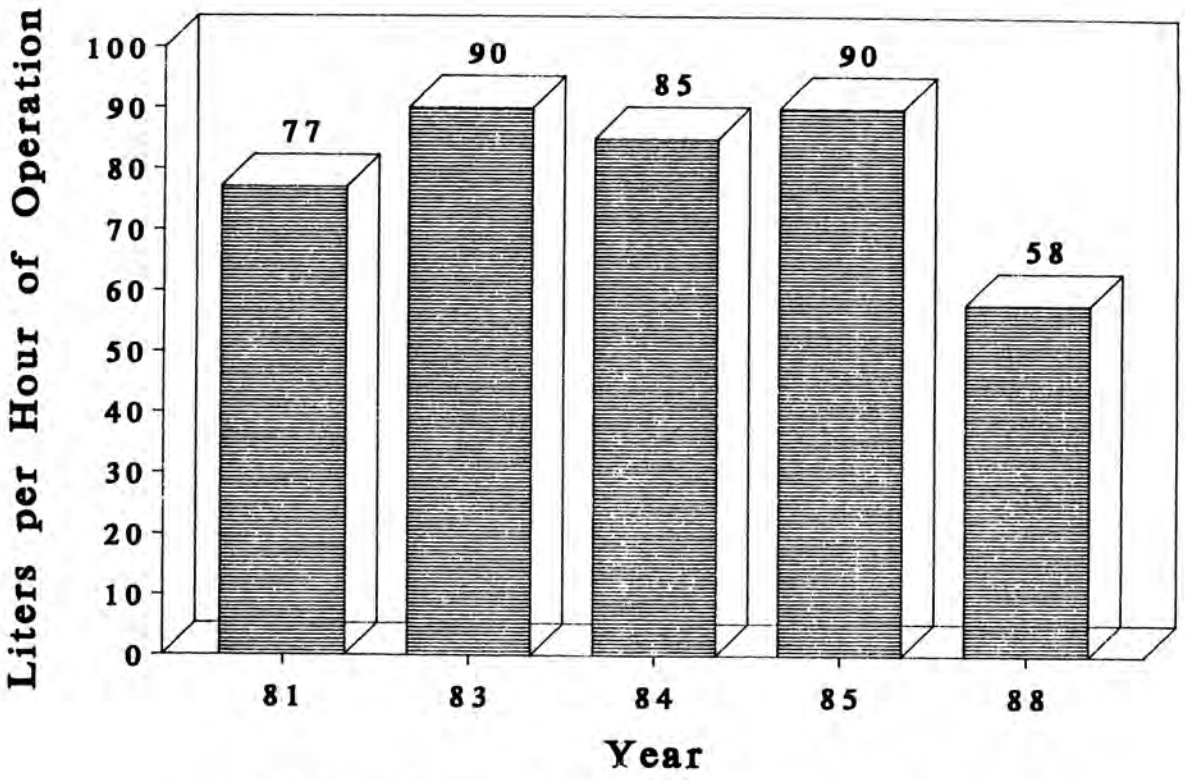

Fig. 3. Average liquid waste generation for the 30-cm calciner pilot plant.