# WASTE DEWATERING PROCESS IMPROVEMENTS AT BRUNSWICK STEAM ELECTRIC PLANT

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## ABSTRACT

In September 1989, Brunswick Steam Electric began with a new waste contractor and compression dewatering system to process the plant's spent powdered and bead ion exchange resins. The waste processing contract included incentives and penalties related to waste volume reduction performance and total processing costs to the plant. This was the first commercial use of its compression dewatering system by the contractor, Westinghouse Radiological Services, Inc. (now part of the Scientific Ecology Group, Inc.). The installation at Brunswick was made in the existing four-cubicle outdoor processing area. The system controls and monitoring are remote. Operating experience to date includes five powdered resin containers and eight bead. Volume reductions of powdered resin wastes indicate a 80% improvement over recent previous processing experience at the plant. Processing times on a per cubic foot of resin processed have been deceased by faster dewatering and less container handling. The dewatered and consolidated waste product characteristics (dry weight percent, density, lack of free water) have been very consistent.

Situated on the mouth of the Cape Fear River, approximately twenty miles from Wilmington, N.C., the Brunswick Steam Electric Plant is a dual unit Boiling Water Reactor rated at 790 Mwe per unit. Unit 2 achieved commercial operation in November 1975, and Unit 1 went commercial in March 1977. All cooling water is highly brackish and dispersed via piping systems throughout both the Reactor and Turbine buildings. The condensate system employs filter/demineralizers for each unit. The radwaste process system also uses filter/ion exchange as the process method for floor and equipment drains.

In 1989, Carolina Power & Light Company contracted with Westinghouse Radiological Services, Inc. (now part of the Scientific Ecology Group, Inc.) to process various ion-exchange and filter media waste streams at Brunswick Steam Electric Plant using the Westinghouse Press-Pak dewatering system. Prior to the mobilization of this contractor to the site, plant radwaste management effected a total waste system clean-out. Other preparations were made by the plant to facilitate waste processing performance measurement. In addition to improved volume reduction of dewatered media, the use of the Press-Pak system and associated process control procedures has provided multiple assurances that the dewatered media substantially exceeds the burial criterion for free water despite some challenging waste characteristics at Brunswick, including an intermittent oil contamination problem.

## WASTE PROCESSING AT BRUNSWICK

Accurate waste processing performance measurement was important because the utility and contractor had agreed upon minimum performance standards for waste volume and processing cost reduction using the contractor's dewatering containers and system. Both financial incentives and penalties were established based upon a performance level that reflected a minimum 10% improvement over the previous contractor's dewatering processing performance.

The bead resin waste streams at Brunswick result from deep bed demineralizer condensate cleanup, waste demineralizer operation, and an auxiliary floor drain demineralizer. The plant uses the practice of exhausting its "spent" condensate resins in the waste cleanup systems. Spent beds are transferred to two phase separators in which decanted waste is held for transfer to the Westinghouse waste processing area. About 2000 cubic feet of bead resin waste is produced annually.

The powdered resin waste streams at Brunswick are produced by polishing and process filters for the condensate filter demineralizer, reactor water cleanup, fuel pool cleanup, and floor and equipment drains processing systems. Spent powdered material is transferred to four phase separators, which in turn are decanted and ultimately transferred to the waste processing area. Approximately 3300 cubic feet of powdered resin waste is produced annually.

Prior to the start of Westinghouse waste processing, the phase separators were emptied (wastes were transferred to the previous waste contractor) and inspected to verify that no residual waste materials remained. System level instrumentation was calibrated and verified. Administrative controls for input accounting and backwash tracking were verified and enhanced. Each step was performed to facilitate future waste processing performance monitoring.

The Westinghouse Press-Pak dewatering system was installed in the existing outdoor waste processing area at Brunswick in September 1989. The area consists of four concrete cubicles for containers up to approximately 215 cubic feet size and a remote operator's building nearby. Three cubicles were equipped with steel shielding lids. Two house process containers. The third encloses a container connected to the process transfer and vent lines as an emergency transfer divert and overflow reservoir, since the plant has no recirculation capability of its transfer lines. The fourth cubicle is open at the top and houses all of the wetted process equipment.

System operation is remotely conducted from the system control panel in the operator's building consistent with the plant's and contractor's dose reduction programs. System operating mode, valve alignment, primary level monitoring and the process container camera monitoring are all controlled by the operator from this panel. The process system is equipped with numerous pressure, vacuum, and flow gauges to provide a complete knowledge of system status.

## PRESS-PAK SYSTEM PERFORMANCE

The Westinghouse Press-Pak compression dewatering system employs an elastic membrane within the dewatering container. Following gross dewatering of the resin solids, the membrane is evacuated to approximately 2 psia, effectively squeezing void space and interstitial water out of the waste mass under a quarter million pounds of compression force. This compression creates freeboard in the dewatering container which accommodates additional waste transfers of waste solids. Forty cubic feet of freeboard space in a 200 cubic foot capacity container is typically generated by the first compression. Typically three or four compression/ transfer cycles are performed on the waste in each container.

Full time level and visual monitoring (using the system camera) is performed through a small top opening in the membrane. The underdrain used is the Westinghouse rapid dewatering design based upon flexible filter sheets. It has a very high flow area to volume ratio (128:1) and therefore can occupy less than 2 cubic feet of the container volume yet provide dewater rates of 25 GPM or more. Virtually all aspects of the system are patented or have patents pending.

As noted earlier, the compression dewatering system was used on bead and powdered resin waste at Brunswick. The application of this system to bead resin wastes was unusual but the objective was to provide an additional measure of precaution against incidental oil. In the Press-Pak compression process, oil in excess of saturation quantities (saturation at 12 psig) would be removed from the waste matrix through the filters and dewater system. Westinghouse tests have proven the efficiency of these filters to pass oily aqueous effluents. Dewatering performance at Brunswick indicated no oil problem, rather dewater flows were clearer and higher (see Figure 4) than were expected.

Some volume reduction of the Brunswick bead resin is achieved in the dewatering process through bed packing during transfers and dewatering. No appreciable additional VR was achieved as a result of the compression process. As a result of this and no recurrence of an old oil problem at the plant, the use of the compression dewatering process on bead resin was recently discontinued at the plant.

Figures 1 and 3 describe the resins and process container used at the plant. Because of the densification of the powdered resin achieved and the resultant contact dose, 179 cubic foot containers were used to ensure maximum cask flexibility when dose exceeded approximately 15 R. A larger container would have exhibited even higher dose rates and the cask availability would have been considerably more limited.

Figures 2 and 4 provide the average performance parameters for the thirteen containers processed to date using Press-Pak. Transferred slurry volumes and dewater rates are direct measurements from available plant and contractor instruments. Resin dry weight percent solids was determined from core samples removed from the processed container. Samples analyzed consisted of equal portions of waste resin from the top, middle, and bottom regions of the container. Level instrumentation determined resin volume as-processed. To calculate the resin-as-new processed in the Radlok, the weight of the dewatered resin was determined by weighing each container. Dividing the product of this weight and the dry solids weight percent by the known dry density of the resin when purchased provides the "resin as new" volume in the container.

Typically a good indication of waste stream and process consistency is waste density as packaged. Figures 2 and 4 reflect averaged performance data. The table below shows how consistent processing results have been at Brunswick. Consistent processing performance has created an experience base that is valuable as a verification of dewatered product quality with respect to the disposal site free water criterion. Two more direct verification methods of meeting the free water criterion are provided in the contractor's containers. Without exception these verifications have indicated that the burial site requirements have been exceeded.

## WASTE DENSITY CONSISTENCY AT BRUNSWICK

| | |
|---|---|
| Powdered Resin (Five Containers) | |
| 54.8 lb/cf Std.Dev. | = 1.7 lb/cf |
| Bead Resin (Eight Containers) | |
| 42.2 lb/cf Std.Dev. | = 2.6 lb/cf |

## BURIAL COST SAVINGS TO THE PLANT

Two volume reduction factors are presented in the figures. Process VR is the ratio of the volume of resin-as-

**POWDERED RESIN PROCESSING AT BRUNSWICK**

**CONTAINER**

| | |
|---|---|
| MODEL: | RADLOK - 179 PP |
| BURIAL VOL: | 179 CF |
| INTERNAL VOL: | 155 CF |

**RESIN**

| | |
|---|---|
| TYPE: | P202H/S502 |
| MIX RATIO: | 90/10 |

Fig. 1. Process Performance Powdered Resin

**PROCESS PERFORMANCE POWDERED RESIN WASTE AT BRUNSWICK**

**PROCESS PARAMETERS**

| | |
|---|---|
| DEWATER RATES: | 1-34 GPM |
| TYP SLURRY VOL: | 4-5000 GAL. |

**PROCESS PERFORMANCE**

| | |
|---|---|
| RESIN AS PROCESSED: | 143 CF |
| RESIN DRY WEIGH PERCENT: | 40.8 % Solids |
| RESIN AS NEW: | 266 CF |

**VOLUME REDUCTION**

| | |
|---|---|
| PROCESS: | 1.86 |
| OVERALL AT BURIAL: | 1.49 |

Fig. 2. Average of five containers processed to date

**BEAD RESIN PROCESSING AT BRUNSWICK**

**CONTAINER**

| | |
|---|---|
| MODEL: | RADLOK - 179 PP |
| BURIAL VOL: | 179 CF |
| INTERNAL VOL: | 155 CF |

**RESIN**

| | |
|---|---|
| TYPE: | EPICOR "CB" MIX |
| MIX RATIO: | 60/40 |

Fig. 3. Process Performance Bead Resin

**PROCESS PERFORMANCE BEAD RESIN WASTE AT BRUNSWICK**

**PROCESS PARAMETERS**

| | |
|---|---|
| DEWATER RATES: | 25-40 GPM |
| TYP SLURRY VOL: | 2-3500 GA |

PROCESS PERFORMANCE

| | |
|---|---|
| RESIN AS PROCESSED: | 146 CF |
| RESIN DRY WEIGHT PERCENT: | 61.2% Solid |
| RESIN AS NEW: | 184 CF |

**VOLUME REDUCTION**

| | |
|---|---|
| PROCESS: | 1.26 |
| OVERALL AT BURIAL: | 1.03 |

Fig. 4. Average of eight containers processed to date.

new to the processed resin waste volume. This is called process VR because this ratio is most reflective of the waste densification or consolidation that the dewatering system achieves. Another ratio labeled here "overall VR" is used to describe the overall improvement achieved in packaging the resin at the plant. Overall VR is the ratio of the volume of resin-as-new in the disposal container to the burial volume of the container, thus it factors in the additional performance aspects of how well the process container is filled and the volumetric efficiency of the process container's design. For comparison, a typical best value for overall VR for dewatering systems currently used under very good processing conditions is 1.3*

From Fig. 2 then, the overall waste packaging improvement achieved at Brunswick on the powdered resin waste stream has been 15% better than could be achieved with other approaches. In fact, by plant records, the improvement over comparable waste processing in the past has been approximately 2:1. On an annualized basis then, this overall improvement to the plant's burial volume for powdered resin waste has been eighty percent.

## SUMMARY

The introduction of the compression dewatering system at Brunswick in 1989 has resulted in several significant processing and cost improvements. Most notably, overall waste volume reduction has been improved for bead and powdered waste streams. Waste dewater rates have also been improved, such that, on a per cubic foot of resin waste basis, waste processing time has actually decreased. The system has performed predictably and resulted in very consistent waste products.

* "Rapid Dewatering of Powder Resings at a BWR", K.W. Hunt, Waste Management '89, Volume 2 - Low Level Waste.