WASTE TO ENERGY PLANT
ENGINEERED SOLUTIONS

Floyd L. Mitchell, P.E., C.P.E.
Nashville Thermal Transfer Corporation

ABSTRACT
This paper has been prepared to encourage communication between plant operators who have developed "in plant" solutions to various problems encountered in waste-to-energy plants. Solutions presented include reciprocating grate designs, dry ash chute designs, ash water reuse clarification system, ash extractor level controls, easy access doors, and water clarification systems. Each problem is presented with solution(s) for each of the problems. A contact is provided for each solution for additional information.

I. RECIPROCATING GRATE MODIFICATIONS

PROBLEM: Our Detroit Stoker reciprocating grate carriages were frequently stalling due to aluminum slag and ash building up on the rails which prevented movement of the wheels. We also had numerous failures of the wheels on the carriages.

SOLUTION #1: The basic idea of this modification (Figure 1 and 2) was to reverse the wheel on rail design so that the rail (an upside down channel) protected the wheels from buildup of ash and aluminum slag. We also moved the drive cylinders to the outside of the stoker siftings hoppers away from the high heat areas, moved the shaft bearings outside of the unit, and used a very strong drive beam for moving the carriages. Since installing this design on two units, there has been no forced outages, no stalls, and no maintenance requirements on these sections.

Contact: Floyd L. Mitchell
Operations Superintendent
(615) 244-3150

SOLUTION #2: The design in Solution #1 could not be easily installed in our first and second section grates due to significant displacement of equipment that would have been required. The solution (Figure 3 and 4) developed was to use the reversal of the wheel on rail modification with internal high temperature carbon bearings supporting shafts inside the units. These have worked successfully to date.

Contact: Tim Hestle
Maintenance Superintendent
(615) 244-3150

II. WATER FILTER ROLLOFFS

PROBLEM: Water is used to quench our bottom ash and to wash down various areas of the plant. Because this water comes in contact with the ash, it must be collected and treated before metered discharge to the city sewer system. This resulted in substantial costs to operation.

SOLUTION: While installing our air pollution retrofit, we needed to furnish a water supply to the scrubber for dilution water, water for the ash ram extractors for cooling, and to the fly ash pug mill. We also realized that our high sewer costs would go higher after the retrofit was completed if we could not eliminate the water discharge. At the same time, the ash landfill operator notified us that we could no longer bring liquid sludge to the landfill that we had been removing from the settling basin of the ash water system. We experimented with plate filters, cyclones, and various other methods to remove the solids and get them in a dry form. None of these proved to be both efficient and economical. We noticed an advertisement in a magazine for a filtration rolloff that had been used in the oil drilling industry. With significant doubts about the chances for success, we rented one box for a trial. The trial was so successful that we have purchased two of the rolloffs. The rolloff box is basically a standard rolloff container with filtering media installed inside. We add a small amount of polymer flocculent to assist in clarification. The water pumped into the box is a very heavy ash laden water. The box settles out the particulate material and returns a clear reusable water. The settled particulate is allowed to dewater and the rolloff hauled to the landfill for disposal. By
reusing this water, we are saving $8,000 per month in sewer charges. It also has provided us with the ability to tell visitors to the plant that we recycle all of our water.

Contact: Gary Skinner
FLO-TREND Systems
(713) 699-0152

III. LEVEL CONTROL FOR TLT ASH RAM EXTRACTORS

PROBLEM: The level control furnished on our TLT extractors could not control the level in the extractors without excessive overflow. The turbulent action of the water behind the ram caused the ultrasonic level detector to read false level. The excessive overflow water had to be processed and discharged to the city sewer.

SOLUTION #1: This solution has been used successfully at several facilities. The modification (Figure 5) requires the installation of a standpipe on the side of the extractor (Figure 6) with the level detector sensing the level in the standpipe. The design is provided with a flush valve to flush the standpipe in case of ash buildup in the piping.

Contact: Bob Kidroski
American Ref-Fuel
(610) 497-8100 Ext. 158

SOLUTION #2: This solution utilizes the installed PLC and water level sensor that was supplied with the units. The PLC is programmed to take a single level reading at a set time (we use 5 seconds) after the completion of the return ram stroke. This allows the water behind the ram to settle so the level detector can get an accurate reading. If the level is below set point, the PLC opens the water inlet pinch valve until the next water level reading is taken. This solution has worked very successfully.

Contact: Phillip Davis
Instrumentation Supervisor
(615) 244-3150

IV. DRY ASH CHUTE

PROBLEM: In installing our new ram extractors, a chute from the stoker discharge to the extractor was needed. Due to past bad experiences with water cooled chutes (leaks, wear, corrosion), we desired a dry ash chute.

SOLUTION: Our vendor for the ash extractors was contacted but could only offer a water cooled design. We decided to design our own chutes. Design considerations were 1) chute would have heavy abrasive wear, 2) occasional high heat excursions, 3) chute could be completely filled with ash, and 4) chute would have to endure heavy shock loading. The design shown in Figures 7 and 8 is the result. For structural support, we used H-beams with flanges at 90 degrees to the wall. This allowed us to use the outside of the beam channel as an air cooling passage. The inside channel (Figure 9) is used to support the wear shingles for the interior. The exterior was covered with 3/8" plate. The interior is filled with refractory. The ash side of the chute is covered with shingles. Loose fitting bolts are used to hold the shingle support bar in the H-beam notch but these do not support the shingle. The shingle is supported by the backing bar of the shingle to the H-beam. The shingles were fabricated to allow room for expansion due to heat and movement due to ash hitting on the shingle.

This design has proven to be very effective. We have had three of these chutes installed for over three years without any maintenance except for several shingles which ripped out by an I-beam being pushed upward by the ram extractor. We have had the chutes filled with burning waste and moved numerous large clinkers through the units without damage. We have never had a hot spot on the exterior of the chutes.

Contact: Floyd Mitchell
Operations Superintendent
(615) 244-3150

V. QUICK ACCESS DOORS

PROBLEM: Our spray dryer head tanks were furnished with internal screens which had to be accessed for cleaning. The furnished access doors were bolted plates which required excessive time and effort to remove and re-install.

SOLUTION: We located a vendor which fabricated ship access ports. These doors are
fabricated for ocean ships and are designed for pressures far greater than the slurry pressure on our head tanks. These doors (Picture 5) feature large knobs which can be operated by hand (no tools required). The doors are designed with waterproof gasketed openings. Our personnel can now open or close the ports in less than 45 seconds where the old access doors could take 10 minutes or more.

VI. WATER CLARIFICATION SYSTEM

PROBLEM: Our water is purchased from the Metro Water system and is a considerable cost of operation. We needed to find another source for supplying water to our plant.

SOLUTION: We had planned to install this system to take river water and create our own supply of non-potable water for boiler water makeup and chilled water makeup. Although we cannot now install this equipment due to the projected plant closure, the equipment is a very excellent method to use non-potable water for a supply source. The filter is basically a sand filter but it has no moving parts. The system is very simple and requires almost no operator attention. Picture 6 is a view of the unit.

Contact: Miguel Gutierrez
DynaSand Filter
(954) 974-6610

VII. GASEOUS CHLORINE REPLACEMENT

PROBLEM: Our location in downtown Nashville caused concern over possible release of chlorine gas. The chlorine gas had to be monitored for our air pollution permit and safety problems with our personnel handling the cylinders all resulted in our need to explore other alternatives to use of gaseous chlorine for cooling tower treatment.

SOLUTION: Our water treatment consultant recommended that we change to a bleach/bromide system. This biocide utilizes hydrobromus acid formed by the combination of bleach (NaOCl3) and 40% solution of sodium bromide (NaBr). The bromine has the following benefits: 1) more effective at higher pH (7.5-9.5), 2) more environmentally acceptable due to a much shorter half life if discharged, 3) much less corrosive to copper and steel, and 4) less safety and legal liability. The bromine treatment does cost a little more but we feel it breaks even when considering the effectiveness of the treatment and liability concerns. Because we run our cooling towers at a pH of 8.0-8.5, this biocide has proven to be much more effective.

ChemTreat, Inc.
James Maslinski
(615) 595-9943
FIGURE 2

- STOKER SUPPORT BEAM
- STOKER SUPPORT BEARINGS
- 6" x 3" x 3/8" S TUBING (ASTM A500)
- 3.4 1/4" RAIL
- 7" SHAFT
- INBOARD BEARING SUPPORTS BOTH LEFT AND RIGHT SHAFTS
- 2 PART HARDENED WHEEL
- SIFTING HOPPER
- 7" SHAFT
- DUST SEAL
- SUPPORT BEARING
- HOPPER RAIL
- SUPPORT BEAM
- GRADE CYLINDER CLEARANCE CONNECTION
- DRIVE BEAM REACHES ACROSS WHOLE GRADE SECTION
- 1/4" (1/8"

EXTERNAL WALL

STOKER
FIGURE 3
# 3 ASH EXTRACTOR

LEVEL CONTROL SETUP

![Diagram of level control setup](image)

**Figure 5**
# 3 ASH EXTRACTOR
LEVEL CONTROL SETUP

FIGURE 5
3/8" C.S. PLATE

8 WF 13

BEAM SLOT
2 1/8" X 1 1/8" DEEP

1/2" GR. 5 HEX Hd BOLT/NUT W/ SPHERICAL WASHER AT HEAD AND FLAT WASHER AT THREADS

3/8" AR 360 PM FRONT AND BACK SIDES
1/2" AR 360 ON RIGHT AND LEFT SIDES

1" X 2" C.S.

SHIM 1/32" FOR 3/8" PLATE AND 1/16" FOR 1/2" PLATE. THEN WELD

TYPICAL SHINGLED PLATE SECTION
DETAIL GG

FIGURE 9