Large-Scale Fly Ash Pond Dewatering With Automatic Membrane Filter Pressing

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Abstract

The US Environmental Protection Agency (EPA) has identified 45 "High Hazard Potential" coal combustion product (CCP) impoundments in the US where "failure or misoperation will probably cause loss of human life (Ref. 1)." One way to mitigate this hazard is to dewater the slurry and eliminate the potential hydraulic and fluid properties of mixture. Using a Jingjin lab press, we dewatered Class F and C fly ash and recovered an 80% solids filter cake that was easy-to-handle, stackable and dry. If we scale-up this operation, we find that a fully automated production-sized membrane filter press could dewater 80 to 110 tons per hour. If an average sized pond contains 44,000 tons of CCP, a bank of 10 Jingjin membrane filter presses could potentially dewater a single pond in about 15 hours.

Keywords: Dewatering, Coal combustion product, Filter press

Introduction

CCP production peaked in 2008 at just under 140 million short tons produced in the United States (Ref. 2). Beneficial use in portland cement concrete, gypsum wallboard, structural fill and other applications has also grown and displaces about 40 percent (%) of the waste stream. The remaining balance is typically stored in ponds, secondary containment, or landfills. New regulations were issued by the US Environmental Protection Agency (EPA) in December, 2014, following the release of more than a billion gallons of ash slurry at the Kingston, Tennessee power plant. Among other things, this new regulation requires storage locations to create comprehensive monitoring programs to address risks posed by groundwater contamination, structural failures, and fugitive dust emissions. An alternative to this is to simply dewater the pond, remove the potential for release or containment failure, and close the site. This can be accomplished using automatic filter press technology.

Method

Class F ash from the Jim Bridger Power Plant (Point of Rocks, WY) and Class C ash from Laramie River Station (Wheatland, WY) was mixed with tap water to create a 30% solids solution (Ref. 3). Each sample had a specific gravity of 1.23. Under continuous agitation, the slurry was pumped into a Tons Per Hour (TPH)/Jingjin Environmental Equipment Company filter press, Model number 250-U, with a Yamada (NDP-20BAC-HP) slurry pump. In the press, Nylon-6 filter cloth was used. After the press was filled, a two to four minute "squeeze cycle" —where the membrane plates are inflated with air to squeeze additional moisture from the slurry—was used. The test was terminated when the water output decreased to ≈1 drop about every three seconds.

Table 1. Pressure and feed times for two different CCP samples

Parameter	Feed time (minutes)	Feed pressure (PSI)	Squeeze time (minutes)	Squeeze Press (PSI)	Resulting Moisture (percent)
Type F Ash	28.5	175	2.75	175	20.5
Type C Ash	19.7	175	4.0	160	21.9

Results

Results for both Class C and Class F ash were nearly the same: Both required ≈20-30 minutes of pump pressurization and 2-3 minutes of membrane pressurization to reach ≈20% moisture. The resulting water was crystal clear and turbidity was not measured. Percent moisture is wet weight-dry weight divided by wet weight. The resulting cake was light, dry and easy-to-handle, as shown in the photographs:

Photo 1. After filter press dewatering: Class C on the left, Class F on the right

Discussion

A 2000 by 2000 millimeter (mm) filter press with 180 plates is a configuration commonly used in the mining industry to dewater slurry from mine tailings. These presses are highly efficient, fully automated, and can be skid mounted for portability. A TPH/Jingjin membrane filter press in this configuration could potentially dewater 80 to 110 metric tons per cycle of slurry using the feed and press times in Table 1. Assuming a cycle time of 20 minutes, a bank of 10 filter presses would be capable of dewatering:

Table 2. Theoretical dewatering capability of 10 filter presses

Yield Per Hour (tons)		Yield Per Day (tons)		Yield Per Month (tons)	
Min	**Max**	**Min**	**Max**	**Min**	**Max**
2,400	3,300	57,600	79,200	1,267,000	1,742,400

Assumes 24 hours per day, 22 days per month, 3 cycles per hour, and 40 mm cake thickness.

In July, 2014, the EPA conducted a survey of surface impoundments and identified 676 units managing slurried CCRs at 240 facilities. Of these, 45 were identified by the utilities as “High Hazard Potential” units. This hazard potential is defined as “Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.” (Ref. 1)

Rule section §257.100 in 40 CFR Part 257 describes the process of closure for existing, inactive impoundments and ponds. One criteria for closure is that “free liquids must be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues” [Ref. 4, §257.100 (b)(2)(1)]. In addition, waste must be stabilized and a cover system should be installed. TPH/Jingjin membrane filter presses offer an effective method to accomplish this goal.

Indiana ranks in the top level of states with coal ash ponds. Thirteen (13) power plants store an estimated 2,270,950 tons of coal ash in ponds (Ref. 5). Assuming the average power plant has four ponds or impoundments, this works out to 44,000 tons of ash per pond. Using an average dewatering rate of 1,900 tons per day, it would take about less than 1 day (15 hours) to dewater and immobilize a single pond of this size. In reality, the system would be further optimized and additional dewatering capacity and lower moisture could likely be obtained.

References

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