Guidance on the Use of Bottom Ash (Cinders) at Dams

PUB-WA-609 2005

WISCONSIN
DEPT. OF NATURAL RESOURCES

P.O. Box 7921
Madison, WI 53707-7921

Purpose
There are two major purposes of this guidance. First, is to clarify that dam operators who desire to use bottom ash (cinders) to seal gates at their dam, need to apply for and obtain a Low Hazard Exemption (LHE). Secondly, to help DNR staff and dam operators in understanding and complying with a LHE for the use of cinders to seal gates at dams.

This guidance is not intended to set minimum standards and other methods and information may be used to obtain a LHE. It's intended that this guidance can be used for warmwater (WW) and coldwater (CW) fisheries, outstanding resources waters (ORW) and exceptional resource waters (ERW). But be aware, for the use of cinders at dams that have OWR or ERW below the dam, an additional step is needed that includes a "no significant impact" determination.

Background
The need for sealing gates at dams has been an issue for a number of years and many materials have been investigated for use. Leaks can occur at the sill plate and where the gate comes into contact with the frame.

Certain cinders (bottom ash / stoker type) have been found the most effective (and least polluting / tested) in sealing leaks at gates. These cinders have an optimum specific gravity (not too heavy or light) and tend to flow into the leaking area. They also have a range of sizes and roughness and tend to form a cinder bridge between the gate and the dam wall that results in plugging the leak.

Excessive leaking at or around the gates or sill plate can cause a number of problems such as;

- Allows algae growth (summer) and makes maintenance of gates difficult due to slippery conditions.
- Allows ice to form (winter) and makes maintenance of gates difficult and a safety issue for maintenance personnel due to slippery conditions.
- Allows ice to form that traps the rubber sealing gasket and causes tearing of the gaskets if the gate needs to be operated.
- Allows ice to form that can overload metal structures or makes opening of gates difficult during high flows.
- Sill plate leaks that can damage the dam structure.

This guidance and the associated low hazard exemption (LHE) is intended to help dam operators balance the issue of cinder usage and protect the safety of the dam and staff, not impede dam operation (especially during emergency conditions or high flows), and minimize cinders from entering waters of the state. [Note: Due to the scarcity of the particular cinders needed and how the cinders are used, the actual amount of cinders ending up in the waterway is very small.]

Use of cinder seal materials
In visiting the Prairie du Sac Dam (August of 2002), several DNR Waste Management staff observed the use of bottom ash (cinders from Capitol Heating and Power) to seal the side of one leaking gate. One shovel (typical pointed garden spade) of cinders was placed near the wall and gate (gate / seal was leaking badly) and within a minute effectively sealed the entire 30 + foot vertical wall of gate. Considering that the cinders are typically only used twice a year to seal the leaks, the limited amount of cinders used and high flows at the dam, cinders use shouldn't have an impact on water quality.

Use of alternate materials
Three other materials have been tried (WI Dells Dam) and these are as follows:

- Sheet plastic (~ 32 mil)
- Oil boom type material (Pig Corp.)
- Cinders in a sand bag

Sheet plastic is cut in a long strip and a weight is placed on one end and a rope tied to the other end. The plastic strip is lowered along the side of the gate and is eventually pushed over the leaks to seal the gate. This isn't a viable option for sealing the bottom of the gate or sill plate and is more effective in sealing large leaks.

Oil boom type material is weighted on one end and a rope is tied to the other end. The oil boom is lowered along the side of the gate and is eventually pushed over the leaks to seal the gate. This isn't a viable option for sealing the bottom of the gate or sill plate and is more effective in sealing large leaks.

Cinders are placed in a sand / burlap bag. The opening is tied with a rope and lowered along the side the gate and is eventually pushed over the leaks to seal the gate. Again, this isn't a viable option for sealing the bottom of the gate or sill plate and is more effective in sealing large leaks.

All three alternatives would seem to be easily recovered when the gates are operated but experience has shown that it isn't always the case. Pressure, friction and/or degradation of the plastic and bags has resulted in the seal material tearing apart or loose from the rope.

When to replace seals
In discussing the use of sealing materials and existing seals with three dam operators, each operator had a plan (not always written) for maintaining their gate seals. This included a set frequency for replacing gate seals and if the leaks were excessive, replacing those seals first.

The definition of excessive leakage is hard to define. In discussions with the operators, it was suggested that needing to use more than 3 or 4 shovels (garden spade) to seal a side of a gate indicated excessive leakage and appropriate repairs should be made.

For those side seal leaks, when excessive leaks are occurring, a weighted plastic sheet or oil boom type materials or sand bags / with cinders can be used.

All Dams (WW and CW fisheries, ORW, and ERW) / Guidance on use of bottom ash (cinders)
Transportation - Cinders shipped to the dam should be transported in a leak proof / covered or enclosed truck [see s. 348.10(2) Wis. Statutes]
Storage - Cinders should be covered prior to use and surface water should be routed away from the storage area.

Testing / Frequency - Physical and chemical leaching properties should be done in accordance with the water leach test, 9 selected parameters, and methods listed in NR 538.06 of the Wisconsin Administrative Code. Testing should be done prior to cinders being transported, from the supplier, to storage for use at the dam(s). If the cinders are from the same source and the source has shown consistency in cinder quality (like the last 3-years of annual tests have been consistent), then consideration should be give to a 3-year testing frequency.
Cinder Use and Minimization - Each dam should incorporate the minimization of cinder usage into their routine dam maintenance of replacing seals and repairing sill plates (if appropriate).
Annual Report/Summary - Each dam should develop an annual report on cinder use and have that report on file at the dam or at the main office. The annual report should, at a minimum, include the following:

- Source(s) of the cinders used.
- Dated copy of the most recent cinder tests (additional testing is only required if additional cinders have been obtained from a different source).
- Estimation of the monthly amount of cinders used (pounds or volume) and the total used in the last calendar year.
- Description of the type and amount of other temporary sealing materials used in the last calendar year.

All Dams (WW and CW fisheries, ORW and ERW) / Determining Compliance with the Statewide Low Hazard Exemption for Bottom Ash (Cinders) Usage
Water Quality Issues - In providing the table below**,** it is the intent that the dam operator can use the water quality information and cinder testing information to determine the acceptability of cinder usage at their dam. This evaluation should be done using the following steps:

Step 1: Determine the hardness of the water body in which the dam is located. Hardness data can be obtained by collecting a water sample and having it analyzed by a certified laboratory or asking the regional DNR water program staff if data is available. If a range of data is provided, the lower bound of that range should be used in the evaluation. [Note: If cinders are to be used only during certain time periods of the year, consideration should be given to collecting water samples and testing for hardness during those times of the year.]

Step 2: Determine if the water body in which the dam is located is considered "coldwater" or "warmwater" fishery or an ORW or ERW. That this determination would apply to the tail water of the dam. This information can be obtained from the regional DNR water program staff.

Step 3: A sample of the cinders that are proposed for use should be analyzed by a certified laboratory. The analytical method should be the ASTM Water Leach Test referenced in NR 538.08(1), Table 1A, Wis. Administrative Code. Ensure that the method detection limits used by the laboratory are below the NR 105 Acute Toxicity Criterion is presented in the following Table, given the water body hardness and fishery classification.

Step 4: Compare the analytical results for the cinders to the NR 105 Acute Toxicity Criterion in the following Table, given the water body hardness and fishery classification.

Example: The Muddy River has a hardness of 110 ppm and is a warmwater fishery. The Cadmium ASTM Water Leach Test result for cinders from Company XYZ is 9 ug/l. Comparing this value to the

NR 105 Criterion for Cadmium (10 ug/l) indicates that the cinders would be acceptable by the DNR for use as a gate sealant.

The dam operator / owner should use the table below, the testing information and analysis to determine the acceptability of their cinders and compliance with the Low Hazard Exemption.

DOWNSTREAM OF THE DAM

Substance	Water Hardness Range in PPM, if applicable	NR 105 Acute Toxicity Criterion (Cinders Test)
Arsenic	all	340 ug/L
Cyanide	all	22 ug/L coldwater, 46 ug/L warmwater
Chloride	all	757 mg/L
Cadmium	20 – 49	0.7 ug/L coldwater, 1.6 ug/L warmwater
	50 – 99	2 ug/L coldwater, 4.6 ug/L warmwater
	100 – 199	4.4 ug/L coldwater, 10 ug/L warmwater
	200 – 299	10 ug/L coldwater, 23 ug/L warmwater
	300 - 399	15 ug/L coldwater, 36 ug/L warmwater
Chromium	20 – 49	0.48 mg/L
	50 – 99	1.02 mg/L
	100 – 199	1.8 mg/L
	200 – 299	3.18 mg/L
	300 and up	4.43 mg/L
Copper	20 – 49	3.4 ug/L
	50 – 99	8 ug/L
	100 – 199	16 ug/L
	200 – 299	30 ug/L
	300 - 399	44 ug/L
Lead	20 – 49	23 ug/L
	50 – 99	55 ug/L
	100 – 199	107 ug/L
	200 – 299	209 ug/L
	300 and up	309 ug/L
Nickel	20 – 49	0.12 mg/L
	50 – 99	0.26 mg/L
	100 – 199	0.47 mg/L
	200 – 267	0.84 mg/L
	268 and up	1.08 mg/L
Zinc	20 – 49	29 ug/L
	50 – 99	66 ug/L
	100 – 199	120 ug/L
	200 – 299	221 ug/L
	300 - 399	315 ug/L

- Criteria are based on the low end of the hardness ranges since metals are more toxic in soft water.
- For cadmium, coldwater refers to trout waters and the Great Lakes; warmwater would be the other rivers and lakes large enough to support sportfish that aren't classified as trout waters. For the other substances, the criteria are the same in both warm and coldwater.
- Copper and nickel criteria are likely to be revised in the near future to reflect comments from USEPA on NR 105; the above concentrations reflect those changes.
- Silver and selenium currently have no acute criteria. Given the ambient mercury levels in Wisconsin waters, criteria other than acute are already exceeded so we don't allow increased mercury levels above background to prevent further degradation.

- DNR's Watershed Management Program can provide values / criteria for the following compounds, if needed: chlorine, pentachlorophenol, gamma-BHC (lindane), endrin, toxaphene, chlorpyrifos and parathion.

Dams Located on an ORW or ERW / Determining Compliance with the Statewide Low Hazard Exemption for Bottom Ash (Cinders) Usage

Water Quality - Water quality discharges to ORW and ERW resources require a "no significant impact" determination. Here are the typical steps that need to be followed to demonstrate that no significant impact will occur from gate sealing by the use of the bottom ash (cinders) for sealing:

Step 1: Select single / typical gate with significant leakage and needs to be sealed.

Step 2: Take a water sample behind the gate (upstream) at about one meter from the gate and from the ~50% depth.

Step 3: Add cinders to start the gate sealing processing.

Step 4: Wait enough time to allow some of the leaking gate water to reach the water on the downstream side of the dam. Take a sample as close to the gate as practical.

Step 5: Test the collected water samples for metals listed in NR 538 Wis. Administrative Code, using appropriate testing methods.

Step 6: Operator or owner needs to provide the DNR regional water program (Regional Water Leader) the sampling data with an explanation of the data results.

Step 7: If the DNR regional water program concludes that there is "no significant impact" and the operator or owner receives a letter or e-mail from the regional DNR water program staff indicating a "no significant impact", then the operator or owner is ready to seek the LHE by submitting a request for the LHE and providing appropriate information.

Low Hazard Exemption. Waste Management Program will review the supporting data that is submitted and, if appropriate, issue a LHE for the use of cinders at the specific dam. See the example LHE request in Attachment A and the LHE template in Attachment B.

ATTACHMENT A - Example Request for A Low Hazard Exemption / Other formats or approaches may be used.

Put letter on company letterhead. Make sure the letterhead has all pertinent contact information, including: company name, street address, phone number, fax number, and email address. If the letterhead does not contain all this information, include it in the letter.

Name of DNR staff person
Bureau of Waste Management
Wisconsin Department of Natural Resources
Address of DNR office

Dear (DNR staff person),

On behalf of (company name), I am requesting a Low Hazard Grant of Exemption for the use of bottom ash (cinders) to seal the leaking dam gate at the (name of dam) which is located on the (name of the river). This river is classified as a (add the correct classification / warm water fishery, cold water fishery, ORW or ERW).

In order to facilitate your review and approval of the request, the DNR "Guidance On The Use Of Bottom Ash (Cinders) At Dams" was used and the following information is being provided:

- Analysis of the cinders (NR 538.08 (1), Wis. Administrative Code)
- Downstream water quality
- An analysis of the leach test results and water quality
- Results of water quality sampling and a "no significant impact determination" (for ORW and ERW only)
- DNR regional water program letter / e-mail concurring with the "no significant impact determination (for ORW and ERW only)

I look forward to your response and if you have any questions, please feel free to call me.

Sincerely,

(sign name)
Typed name, title
Company name

ATTACHMENT B – Low Hazard Exemption (use appropriate regional letterhead)

Month, day and year

Name of dam operator
Address of the dam operator
City, state and zip code

Re: Conditional Grant of Exemption for Use of Bottom Ash (Cinders) as Seals for Dam Gates

Dear (name of dam operator):

The Department is issuing this grant of exemption from regulation under ch 289, Wis. Stats., for the use of cinders for the sealing of the gates at the (name of the dam) located on the (name of river). The cinders used must be generated by combustion of coal or clean wood by an industrial boiler(s), be managed and used in compliance with the conditions of this exemption.

This grant of exemption constitutes a Department-issued approval and allows the use of cinders for dam gate seals and will terminate ten (10) years from the date of this approval.

The conditions of the approval include testing requirements, cinder use minimization, documenting of cinder utilization and other sealing methods, documenting of flows at the dam and developing an annual report that can be reviewed by Department staff. Conditions of the grant of exemption require testing of each source of cinders (not each shipment) prior to being shipped for use at the dam.

For use of cinders at a dam on an outstanding resource water (ORW) or exceptional resource water (ERW), the dam owner or operator is required to have a letter from the Department indicating a "no significant impact" determination has been made by the Department. This letter must be obtained prior to the use of the bottom ash (cinders).

Under the authority of the grant of exemption, cinders that are used to seal dam gates are exempted from tonnage fees.

If you have any questions concerning this letter, please contact (name of regional contact and telephone number).

Sincerely,

DNR staff person
Staff title
Bureau of Waste Management

BOTTOM ASH (CINDERS) USE SUMMARY

The use of bottom ash (cinders) and other combustion products for dam sealants has been an historical practice that has long predated formal regulation of these materials as solid wastes. The rationale for using cinders or other materials, including other types of solid wastes, has to do with the integrity and operation of gates used to regulate flow and volume of water through the dams used for hydro power generation and for water supply for industrial manufacturing. Gaps between the gates and frames can allow water to seep through causing structural damage and develop layers of ice or algae on the exposed downstream side of the gate. Ice buildup on the gate can lock the gates in closed positions. This can result in potentially hazardous operating conditions during springtime, when gates may need to be opened quickly to control water levels. Reducing the magnitude and velocity of water flow through a leak limits erosion or damage to the concrete holding the frame and dam gate. An additional concern for some dams is the water volume lost.

Dam operators have tried various materials to seal leaks without locking the gates or causing other problems. Through experience, various operators have found that some combustion products, including cinders and slag can be introduced to leak sites either by dropping the cinders or slag into the water stream entering the leak or by suspending bags of cinders or slag in front of the leaks. The physical properties that make such materials useable are dependent on the type of furnace or boiler that the coal is combusted in. The specific gravity of ash is between that of sand and gravel (which sink too fast) and light-weight organic or inorganic materials (which tend to float or disperse). The gradation of the sealant material has to be broad enough to allow development of a filter that clogs leaks. The sealant material also has to be suitably hard enough to be durable in use and inert enough to not react with or harden on the gate or frame materials.

The Department notified several dam operators in 1987 that only certain sources of cinders could be used as dam seals due to their relatively low leachability. Other sources could be utilized if proposed to the Department with leach test data.

Cinders are a high-volume industrial waste as defined in ch 289.01(17), Wis. Stats., and exemptions to encourage recycling of high-volume industrial waste are allowable under ch 289.43(7), Wis. Stats. The proponent of a grant of exemption has to provide information and data to demonstrate that use of cinders or other high-volume industrial wastes will not cause detrimental effects to surface water or groundwater or have a significant impact to other protected resources.

This grant of exemption is applicable only to cinders obtained from boilers which combust coal or untreated wood or bark but is applicable to cinders and slag from stoker boilers as well as the bottom ash from pulverized coal boilers.

This exemption is limited to dams that comply with a Low Hazard Exemption issued by the Department.

BEFORE THE
STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

CONDITIONAL GRANT OF EXEMPTION
FOR
BOTTOM ASH (CINDERS) USED TO SEAL DAM GATES

FINDINGS OF FACT

The Department finds that:

1. That dams that operate water retention dams that have mechanical gates to control water levels may need to take leak control measures through the use of bottom ash (cinders) to seal those leaks.

2. The Department evaluated cinders usage and the potential for contaminant leaching into surface water by leaching test data. The outcome of the evaluation is presented in the Waste Management Program's guidance "Use of Cinders at Dams Guidance", dated January 21, 2005 and approved by Suzanne Bangert, Director for the Bureau of Waste Management.

3. The conditions set forth below are needed to assure that exempted uses of cinders are conducted in an expeditious manner while preserving the Department's ability to minimize environmental impacts. The conditions set forth in this grant of exemption are necessary to assure protection of the environment and to prevent contamination of surface water. If the conditions are complied with, the proposed exemption will not inhibit compliance with the applicable provisions of ch. 30, 31, 160, and 280 to 299, and ss. 1.11, 23.40, 59.692, 59.693, 60.627, 61.351, 61.354, 62.231, 62.234, and 87.30, Wis. Stats.

CONCLUSIONS OF LAW

1. Based on the foregoing, the Department has the authority under s. 289.43(7), Stats., and ss. NR 500.08(5), Wis. Adm. Code, to issue a grant of exemption if the exemption would not inhibit compliance with the applicable provisions of ch. 30, 31, 160, and 280 to 299, and ss. 1.11, 23.40, 59.692, 59.693, 60.627, 61.351, 61.354, 62.231, 62.234, and 87.30, Wis. Stats.

2. The Department has authority to approve a grant of exemption with conditions if the conditions are needed to ensure compliance with the applicable provisions of ch. 30, 31, 160, and 280 to 299, and ss. 1.11, 23.40, 59.692, 59.693, 60.627, 61.351, 61.354, 62.231, 62.234, and 87.30, Wis. Stats.

3. The conditions set forth below are needed to ensure compliance with the applicable provisions of ch. 30, 31, 160, and 280 to 299, and ss. 1.11, 23.40, 59.692, 59.693, 60.627, 61.351, 61.354, 62.231, 62.234, and 87.30, Wis. Stats.

4. In accordance with the foregoing, the Department has the authority under s. 289.43(7), Wis. Stats., and NR 500.08(5), Wis. Adm. Code, to issue the following conditional grant of exemption.

CONDITIONAL GRANT OF EXEMPTION

The Department hereby approves the exemption for the use of bottom ash (cinders) for sealing at **(Name of the dam)** located on the **(Name of river)**. The use of cinders shall be subject to the following conditions:

1. The use of cinders for dam seals shall be tested for their physical and chemical leaching properties and shall be evaluated in accordance with the water leach test, parameters, and methods listed in NR 538 of the Wis. Administrative Code. Testing of each source of cinders (not each shipment) shall be done prior to the cinders being used the dam.

2. The use of cinders shall be limited by the following chart:

DOWNSTREAM OF THE DAM

Substance	Water Hardness Range in PPM, if applicable	NR 105 Acute Toxicity Criterion (Cinders Test)
Arsenic	all	340 ug/L
Cyanide	all	22 ug/L coldwater, 46 ug/L warmwater
Chloride	all	757 mg/L
Cadmium	20 – 49	0.7 ug/L coldwater, 1.6 ug/L warmwater
	50 – 99	2 ug/L coldwater, 4.6 ug/L warmwater
	100 – 199	4.4 ug/L coldwater, 10 ug/L warmwater
	200 – 299	10 ug/L coldwater, 23 ug/L warmwater
	300 - 399	15 ug/L coldwater, 36 ug/L warmwater
Chromium	20 – 49	0.48 mg/L
	50 – 99	1.02 mg/L
	100 – 199	1.8 mg/L
	200 – 299	3.18 mg/L
	300 and up	4.43 mg/L
Copper	20 – 49	3.4 ug/L
	50 – 99	8 ug/L
	100 – 199	16 ug/L
	200 – 299	30 ug/L
	300 - 399	44 ug/L
Lead	20 – 49	23 ug/L
	50 – 99	55 ug/L
	100 – 199	107 ug/L
	200 – 299	209 ug/L
	300 and up	309 ug/L
Nickel	20 – 49	0.12 mg/L
	50 – 99	0.26 mg/L
	100 – 199	0.47 mg/L
	200 – 267	0.84 mg/L
	268 and up	1.08 mg/L
Zinc	20 – 49	29 ug/L
	50 – 99	66 ug/L

Substance	Water Hardness Range in PPM, if applicable	NR 105 Acute Toxicity Criterion (Cinders Test)
	100 – 199	120 ug/L
	200 – 299	221 ug/L
	300 - 399	315 ug/L

3. This exemption shall terminate ten (10) years from the date of this grant of exemption.

4. The use of cinders for dam gate sealing shall comply with the following:
   a. Transportation - Cinders shipped to the dam shall be transported to in a leak proof (s. 348.10(2) Wis. Stats) and covered or enclosed truck.
   b. Storage - Cinders shall be covered prior to use and surface water shall to be routed away from the storage area.
   c. Cinder Use and Minimization - The dam shall incorporate the minimization of cinders usage into their routine maintenance of replacing seals and repairing sill plates (if appropriate).

5. Annual Report. An annual report/summary shall be developed by May of each year. The report shall cover January 1 to December 31 of the previous year and contain the following information, at a minimum:
   a. Date and amount of cinders used (pounds or volume) during each sealing event and the yearly total amount used.
   b. Date and type of other sealing materials (non-cinders) used like commercial products, or other materials.
   c. Date when cinders or other sealing materials are lost due to opening a sealed gate(s).
   d. Identification of the source of the cinders used for sealing and the furnace type producing the cinders.
   e. For ORW and ERW dam locations, include the DNR "no significant impact" determination letter.

6. The dam owner shall notify the operator of the dam that the Department reserves the right to make inspections.

The Department reserves the right to require the submittal of additional information and to modify this grant of exemption at any time, if in the Department's opinion, modifications are necessary.

NOTICE OF APPEAL RIGHTS

If you believe that you have a right to challenge this decision, you should know that Wisconsin statutes and administrative rules establish time periods within which requests to review Department decisions must be filed.

For judicial review of a decision pursuant to ss. 227.52 and 227.53, Wis. Stats., you have 30 days after the decision is mailed, or otherwise served by the Department, to file your petition with the appropriate circuit court and serve the petition on the Department. Such a petition for judicial review shall name the Department of Natural Resources as the respondent.

DEPARTMENT OF NATURAL RESOURCES

For the Secretary

_____

DNR staff person
Staff title
Bureau of Waste Management

Contact DNRWasteMaterials@wisconsin.gov for further information.

Disclaimer: *This document is intended solely as guidance and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.*

Equal Opportunity Employer and Americans with Disabilities Act Statement: *The Wisconsin Department of Natural Resources provides equal opportunity in its employment, programs, services, and functions under an Affirmative Action Plan. If you have any questions, please write to Chief, Public Civil Rights, Office of Civil Rights, U.S. Department of the Interior, 1849 C. Street, NW, Washington, D.C. 20240.*

This publication is available in alternative format (large print, Braille, etc.) upon request. Please call 608-266-2111 for more information. Note: If you need technical assistance or more information, call the Accessibility Coordinator at 608-267-7490 / TTY Access via relay – 711.