
ZOI Fibrous Debris Preparation: Processing, Storage and Handling

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Nuclear Energy Institute

Generic Procedure

ZOI Fibrous Debris Preparation: Processing, Storage and Handling

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ZOI Fibrous Debris Preparation: Processing, Storage and Handling

1. SCOPE

This document covers the procedures for processing, storage and handling of the fiber that will be used in sump strainer testing. The resulting fibrous debris from this procedure is intended to represent fibrous material generated as a result of jet impingement within the appropriate zone of influence (ZOI). The overall test program is described in a test plan. This document is intended to outline the procedures to be used by the technical support team to process, store and handle fibrous debris that will be used as part of the test program. The material will be procured externally and processed to meet the requirements before it is used.

2. PURPOSE

The purpose of this document is to ensure that the requirements for processing, storage and handling of the fibrous debris that will be used for the XYZ Sump Strainer Test Program will be met, and that any additional requirements relating to processing, storage and handling are also identified.

3. DEFINITIONS

- Fines – readily suspendable in water (Classes 1 through 3 of Table 3-2 of NUREG/CR-6808)
- Small pieces – clumps of fibers \leq 4 inches on a side (Classes 4 through 6 of Table 3-2 of NUREG/CR-6808)
- Large pieces – clumps of fibers $>$ 4 inches on a side (Class 7 of Table 3-2 of NUREG/CR-6808)

4. GENERAL REQUIREMENTS

- The fiber required for the testing is specified in the test plan as to the type of material to be used for preparation per this document, e.g., Nukon, Mineral Wool, Temp-Mat, etc. The fibers will be processed as fines, small pieces, and large pieces, as dictated by the test plan.

- All weight measurements shall be performed using calibrated scales.
- The weighed debris must be stored and clearly labelled with weight, type, and date. This is done to prevent the possibility of incorrectly identifying the material at the time of its use. Documentation of the weighed debris shall be per the requirements of the test plan.
- The debris must be handled in a safe manner to ensure minimal hazard to personnel. Each relevant material safety data sheet (MSDS) must be read before handling debris and each worker must wear appropriate personal protective equipment (PPE).
- A data sheet, in a form similar to Attachment B, shall be used to document the completion of the applicable steps of this procedure.

5. RESPONSIBILITIES

The Scope of Work will be performed in accordance with this document and the test plan developed for the specific client.

6. PROCESS

This section identifies the procedures to be used to procure, store, process and handle fibrous debris. Fibrous debris will be heated on a hot plate to simulate the aged insulation in the plant before a loss of coolant accident (LOCA), and processed to achieve the required fiber size distribution.

6.1 Safety

Due to its potential negative effect on health and status as an irritant, the fiber material requires appropriate safety precautions when handling. These procedures are outlined in Appendix A. Due care must be used to ensure operator safety.

6.2 Initial Procurement and Storage

Fiber materials will be procured from specified manufacturers. The procured materials will be stored in a sheltered location prior to further processing. The fiber will normally be received as rolls or bundles.

6.3 Aging of Fiber

NOTE

Fiber material that had previously been heat treated, but may not have had full documentation as provided in the following steps may still be used for final debris size preparation provided a visual inspection of the acceptability of the heat treatment (as described below) is performed and documented within the test plan.

- The fiber shall be aged by heating one side of the insulation on a hot plate at 300°C, \pm 38°C for 6 to 8 hours. (Previous testing has shown this temperature and time to be adequate to appropriately age the material.)

The specific aging procedure is as follows:

- A batch (sheet) of fiber is placed on the hot plate.
- A method is provided to periodically monitor plate temperature.
- The hot plate is energized with the time of starting recorded.
- When plate temperature reaches the required temperature, the time is recorded (start of 6 to 8 hour heating).
- After time at temperature, the hot plate is deenergized. This time is recorded.
- When safe to do so, the insulation material is removed from the hot plate and allowed to cool to near ambient conditions.
- The insulation is then inspected to ensure the heat treatment was effective. Inspection criteria for acceptance is a gradient of color in the fiberglass from the hot face to approximately half way through the thickness of the insulation sheet commensurate with the temperature gradient through the insulation sheet. (Reference 7.b)
- The aged fiber is then weighed and placed into labelled bags that identifies the type of fiber, how processed, and the weight.

6.4 Storage of Fiber

The aged insulation is stored in a sheltered location approved by the testing engineer. Each bag is labelled to identify how the debris was processed, the type of debris, the batch number and the lot number, if available.

NOTE

Prior to performance of Step 6.5, if used, the mass of material specified by the test plan shall be obtained as specified in the first two bullets of Step 6.6. Post-soaking weights do not need to be obtained.

6.5 Soaking of Aged Debris (Optional)

As specified by the test plan, the aged debris may be soaked to remove the aging produced particulate matter such as unattached binders and combustion products. This is done by soaking the fibrous debris in a container of water for no less than two minutes and then draining the contents through a Tyler 65 mesh screen (or functional equivalent) to remove small particles and excess water. If used, this step should be accomplished just prior to subsequent steps to prepare the fibers for testing. Long term storage of wetted materials in closed containers should be avoided.

6.6 Preparation of Aged Debris Fines

NOTE

Wetted materials should not be stored for longer than approximately 24 hours prior to use due to the potential for changes to the properties of the material.

- The mass of fiber required by the test plan is identified and this quantity is removed from the bulk aged material through either mechanical means (shears, knife, or equivalent) or by hand separation.
- The removed aged fiber is then weighed and recorded.
- Smaller batches of fiber are then separated from the quantity separated from the bulk quantity by pulling material such that the final volume will result in a fiber to water ratio of ≤ 0.72 lbs/gal (86 gm/l) of water.
- The smaller batches of fiber are then placed in the bottom of a suitable container (typically a cut off section of a plastic barrel) that has been rinsed clean of other materials and contains the required amount of water necessary to maintain the specified fiber volume to water ratio.

NOTE

- Precautions should be taken during the following step to minimize direct impingement of the water jet on the fibers.
- The quantity of water required for the following step is not as important as the ability to verify that the fibers are separated and readily suspendable in the resulting solution.

- Fiber separation is then accomplished by using a high pressure water jet from a commercially available 1500 psi pressure washer with a small diameter fan type tip (recommended), with the nozzle maintained at slightly above or slightly below the water surface. The time necessary to separate the clumps into individual fibers varies, but is generally accomplished within about 2 to 4 minutes.
- The degree of fiber separation is confirmed, by visual inspection, to meet expectations and consistency with previous batches, including meeting the definition of fines provided previously.
- Several batches, prepared as described above for subsequent introduction and use in testing, are then mixed together to create the quantity needed for testing. The batches that are mixed should be combined such that the combined mixture results in a fiber mass to volume of water ratio less than or equal to approximately 0.21 lbs/gal (25 gm/l). The combined materials are then agitated through use of the pressure washer previously described or with other mechanical agitation (paddle or paint stirrer) prior to addition to the test loop. The test plan shall contain the necessary step to verify that minimal agglomeration of the fibers has occurred at the time of addition to the test loop.

6.7 Preparation of Aged Debris Small and Large Pieces

NOTE

Wetted materials should not be stored for longer than approximately 24 hours prior to use due to the potential for changes to the properties of the material.

- The mass of fiber (small or large pieces) for each specific addition is measured and soaked in a sufficient quantity of water in a suitable container, or as specified by the test plan.
- The mixture is then stirred with a hand paddle until the pieces are fully saturated and separated from one another (usually 30 seconds to one minute).
- The degree of fiber clumps separation is confirmed to meet expectations and consistency with previous batches, including meeting the definition of small or large pieces previously provided.

6.8 Photographs of Fibrous Debris

Prior to the fiber addition, photographs of prepared fiber may be taken to confirm that the desired size distribution is acceptable.

6.9 Records

The test plan shall specify the methods to be used for documenting the debris preparation information generated as a result of this document. For fibrous debris preparation, the Datasheet shown in Appendix B is an example of the type of documentation that can be used. The Datasheet records key information such as material processing date(s), reference purchase order number, mass, instruments used, etc.

7. REFERENCES

- a. Revised Guidance for Review of Final Licensee Responses to Generic Letter 2004-02, "Potential Impact of Debris Blockage On Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors", March 28, 2008 (ML080230234)
- b. NUREG/CR-6808, "Knowledge Base for the Effect of Debris on Pressurized Water Reactor Core Cooling Sump Performance," February 2003

Appendix A

Safe Handling of Fibrous Materials

Fibrous materials can cause irritation due to contact (see MSDS before handling). In addition, some of the fibers or fiber products produced can be inhaled or ingested which represents a personnel risk unless necessary precautions are taken. Personnel handling this material should wear appropriate PPE, including an appropriate air filtration mask, safety glasses, gloves and long-sleeved clothing to prevent skin irritation. If necessary, a shower should be taken after handling to remove fibers. Care should be taken during processing and handling to minimize airborne fibers.

Appendix B

Example Datasheet for Fibrous Material Preparation

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