



TITLE: Corrosion Issues Related to Bagasse Fiberboard Roof Insulation in the Gulf States Region of the United States

DESIGNATION: RCI-TA-010-2016

OBJECTIVE: To provide commentary on corrosion linked to the use of bagasse fiberboard insulation in low-sloped roofing assemblies.

A. BACKGROUND

- Fiberboard roof insulation has been used for many years, primarily as a cover board, and in direct-to-deck applications in low-sloped roofing assemblies. Fiberboard, incorporated into roof assemblies, generally has a successful track record when installed in accordance with acceptable guidelines. Fiberboard roof insulation is compatible with bitumen and adhesives and has both thermal and dimensional stability.
- Fiberboard roof insulation is composed of binders along with refined and partially refined lingo-cellulosic fibers that have historically been from wood or bagasse (i.e., dry, fibrous residue remaining after the extraction of juice from the crushed stalks of sugarcane). During the manufacturing process, these materials are combined with water to form a slurry that is deposited onto a moving screen to form sheets of varying thicknesses. The wet mass is subsequently heated for a specific time at a specific temperature and cut to size after that process. Some fiberboard roof insulation products are made at desired thickness and then post-laminated to produce thicker finished boards. Whether from bagasse or wood fibers, the two types of finished fiberboard roof insulations are difficult to tell apart.
- Premature corrosion of steel roof decks has been discovered and confirmed in the Gulf States. The Gulf States region of the United States includes the U.S. southern states that share a border with the Gulf of Mexico. These states are Texas, Louisiana, Mississippi, Alabama, and Florida. Other regions may have similar issues, but none have been confirmed by the RCI Technical Advisory Committee (RCI-TAC).
- Bagasse fiberboard was manufactured for a number of uses, including roof insulation. A limited number of corrosion problems have been reported for low-sloped roof systems incorporating bagasse fiberboard roof insulations.

B. REPORTS

- In January 2011, Chuck Marvin, RRC, and Bruce Byrne described in *Interface* field investigations of three less-than-10-year-old buildings having comparable roof assemblies consisting of a flexible single-ply

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membrane set on bagasse fiberboard roof insulation placed directly on a steel deck. Among their findings, they reported that the decks were severely corroded, including portions that were rusted through to the extent that the potential for fall-through was “a real safety issue,” and thus needed replacement.

- In March 2012, Mark Graham of the National Roofing Contractors Association (NRCA) reported that corrosion of metal fasteners and metal decks had been observed on projects that incorporated the use of “specific fiberboard insulation products” in low-sloped membrane roof systems. The article did not describe the corrosion protection of the metal components for the cases cited by the NRCA. The “specific fiberboard insulation products” were further defined within the report as bagasse fiberboard. Of note, this NRCA article cautioned—consistent with the admonition voiced by Marvin and Byrne regarding safety—that corrosion of the steel roof deck portions that directly contact the fiberboard insulation is “of particular concern because it can result in reduced load capacity of the roof deck and possible worker injury.”
- In July 2012, Mark Hopmann and Kimberly Steiner also reported in *Interface* on field investigations of low-sloped roofing systems having a single layer of fiberboard roof insulation placed directly on steel decks experiencing corrosion.

C. RESULTANT HAZARDS

- Corrosion of metal decks, if extreme, can:
 - Create a lack of support for the roof assembly,
 - Weaken the wind uplift capacity of the roof and deck,
 - Reduce the load-carrying capacity of the deck, and
 - Pose a potential hazard to the safety of those who access the roof and/or the building occupants.
- Corrosion of metal fasteners, if extreme, can lead to premature failure of the fasteners and potentially weaken the wind uplift resistance of the roof assembly.

D. RCI CONSULTANT MEMBER SURVEY

- To further examine corrosion issues associated with bagasse fiberboard roof insulations in low-sloped roof assemblies, the RCI-TAC conducted a survey of RCI consultant members in conjunction with the review of literature citations. The resultant information indicated that for most applications in which corrosion was observed for metal components (i.e., decks and/or fasteners) in direct contact with fiberboard roof insulation of any type, the corrosion was associated with roofs that were aged, leaking, and lacking maintenance. This general finding contrasted with the reported and confirmed premature corrosion cases addressed by this Technical Advisory. On the other hand, one survey respondent provided two reports that described corrosion of metal decks in contact with bagasse fiberboard roof insulation that was akin to the corrosion cases that Marvin and Byrne, and Hopmann and Steiner reported.
- The responses to the survey came from a request to the general consultant membership of RCI. It is known that some RCI consultant members specifically involved with this issue, but still involved with a phase of argumentation/problem resolution, did not respond.



E. ORIGIN AND DISCUSSION OF THE PROBLEM

- Although corrosion of metal decking has been confirmed, and discussion concerning the potential corrosion of fasteners is noted, the exact cause/source or mechanism of corrosion has not been fully determined at this time. Further, at this time, the origin of the corrosion has not been fully explained in the articles or resources used by those authors and cited above.
- The majority of the industry currently believes that the corrosion problem may be related to the incorporation of bagasse fibers into fiberboard roof insulation. In all cases, the fiberboard roof insulations in the reported problematic roofs were believed to be bagasse-based fiberboard.
- It is understood that bagasse fibers were used to produce fiberboard roof insulation at one manufacturing plant in the United States that is no longer in operation. The years of production of this bagasse fiberboard roof insulation at that plant were generally believed to be between 2001 and 2006. However, bagasse fiberboard has been manufactured since 1921 and was used as roof insulation for at least some of the 80 years prior to 2001.
- Marvin and Byrne reported that prior to its use in insulation production, bagasse is treated with liquid chlorine to prevent the development of microbial growth during open field storage near the fiberboard production plant. This chlorine can remain in the finished fiberboard, and due to subsequent leaching, accelerate corrosion of metallic components during service when exposed to moisture from sources such as roof leaks and/or elevated humidity. [Note: The North American Fiberboard Association (NAFA) has informed the RCI-TAC that liquid chlorine was not applied to bagasse fiber during storage or any other step of the manufacturing process.]
- Hopmann and Steiner considered that Marvin and Byrne's conclusion that leaching of chlorine from bagasse fiberboard roof insulation did not explain all instances of corrosion associated with these products. Rather, in reporting on corrosion investigations of roofs incorporating bagasse fiberboard roof insulation, they described that corrosive agents other than chlorine can come from the fiberboard material itself. Specifically, they reported that their findings revealed corrosion of the metal components is related to carboxylic acid emission, water-soluble chlorides, or vapor-phase exposure to acetic acid from the bagasse fiberboard roof insulation products examined in their investigations. In support of this finding, they referenced literature citations indicating that acetic and formic acids are known to be emitted from wood-based products upon exposure to elevated temperatures. In citing this literature, they cautioned that carboxylic acid emission could also occur with wood fiberboard products in roof assemblies. They also noted that no literature was found describing corrosion related to wood-based fiberboard roof insulation. [Note: Consistent with this latter statement from Hopmann and Steiner, the RCI-TAC found no reports of premature corrosion related to roofing applications caused by any fiberboard product except bagasse fiberboard.]
- Neither the NRCA nor the NAFA has discussed the mechanism resulting in corrosion of metal fasteners and decks in contact with bagasse-based or other types of fiberboard insulation. The Steel Deck Institute (SDI) has stated that that the corrosion of steel roof decks is related to chemicals used to treat the bagasse during the production process. SDI provided no further details.

F. SUMMARY

- Since 2011, there have been a limited number of documents in the roofing literature describing the corrosion of steel decks and/or fasteners in contact with fiberboard roof insulation. These reports have



indicated that the corrosion has occurred at an accelerated rate and has been, in the extreme, extensive enough to cause life-safety concerns such as the potential for roof fall-throughs.

- All reported corrosion issues, to the best of the RCI-TAC's knowledge, have been associated with roof assemblies incorporating bagasse and not wood fiberboard roof insulation. The manufacture of bagasse fiberboard was reported to have ceased in 2006. To date, the mechanism resulting in corrosion problems has not been fully defined or described. To date, the RCI-TAC confirmed that occurrence of all reported corrosion issues have been localized in the Gulf States region of the United States. Other regions may have similar issues, but none have been confirmed.
- For building envelope consultants, roofing contractors, and others who may have reason to inspect low-sloped roof assemblies with fiberboard roof insulation, it may be difficult to identify by visual observation only whether the insulation is bagasse-based or wood-based. Cane bagasse fiberboard has a slightly more coarse appearance but is very similar in appearance to wood-based fiberboard.

D. RECOMMENDATIONS

- Review metal components for corrosion when performing an evaluation of an existing roof that contains fiberboard roof insulation. Special attention for buildings localized in the Gulf States region of the United States is merited. Other regions may have similar issues, but none have been confirmed. It may be warranted to conduct a more thorough investigation when it is known that fiberboard has been incorporated into a roof assembly and especially when in direct contact with steel roof decks. Specifically, larger and more test cuts vs. cores, more comprehensive examination of the underside of the metal deck, a review of fasteners used in the system, and other potential points of corrosion are worthy of inclusion.
- It is important to note that evidence of corrosion may not be readily visible or obvious from the underside. A review of conditions prior to accessing the roof is advised to ensure the safety of those persons accessing the roof.

F. REFERENCES

- Chuck Marvin and Bruce Byrne, "Roof Decks Quickly Corroded by Insulation," *Interface*, RCI, Inc., January 2011.
- NAFA response to Marvin and Byrne, North American Fiberboard Association, January 2011.
- Mark Graham, "A Concern With Fiberboard Insulation," *Professional Roofing*, National Roofing Contractors Association, March 2102.
- "A Concern With Inaccurate Allegations Regarding Wood Fiberboard," NAFA response to the Graham article, North American Fiberboard Association, March 15, 2012.
- Steel Deck Institute, position statement, Steel Deck Corrosion Caused by Specific Fiberboard Product," May 2012.
- Mark Hopmann and Kimberly Steiner, "Premature Metal Deck Corrosion: Difficult to Detect and Diagnose," *Interface*, RCI, Inc., July 2013.
- NAFA comments on Hopmann and Steiner article, North American Fiberboard Association, June 26, 2013.
- NAFA response to the Hopmann and Steiner article, North American Fiberboard Association, July 2013.