Attachment 11

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Re: Control of TRS Emissions from the New-Indy Containerboard Catawba, S.C. Kraft Pulp Mill

Dear Mr. Federico

You have asked me to review the reported operations at the New-Indy Containerboard Pulp and Paper Mill in Catawba, South Carolina and provide an evaluation of how hydrogen sulfide (H_2S) and other malodorous and toxic gases are generated at that mill, how they are released to the atmosphere, and how they can be controlled so that the communities downwind of the mill are not affected by the gases.

I have reviewed a number of documents related to the New-Indy mill, including those listed in the attachment, and have applied my knowledge and more than 40 years of experience related to the kraft pulp and paper industry in Canada, the United States, and beyond to provide the following findings. The findings and opinions in this letter are offered to a reasonable degree of scientific probability and are based on my review of publicly available documents, including those listed in the attachment. I reserve the right to modify and/or supplement my findings and opinions as more information becomes available.

EDUCATION AND EXPERIENCE

I specialize in the science and technology of kraft pulping, with a strong focus on processes, product quality, and kraft mill performance. I have been a member of PAPTAC and TAPPI (the North American pulp and paper technical associations) for 40 years, and have been active in committee activities, conference program development, and teaching. A TAPPI Fellow since 1993, I was the recipient of their 1997 Pulp Manufacture Division Technical Award, the Richter prize, and their David Wetherhorn Award (twice).

I am the author of more than 60 scientific publications, 40 technical articles, and six patents. I have spoken, consulted, and taught throughout North America, Europe, Australia, New Zealand, and Japan. My professional work has taken me to more than 60 pulp and paper mills, including the New-Indy Catawba, S.C. mill in 2005 when it was owned and operated by Bowater.

I received MS and PhD degrees from The Institute of Paper Chemistry, Appleton, WI. and a BSc (Chemistry and Geology) from McGill University in Montreal, Canada. I served as senior research scientist at the Pulp and Paper Research Institute of Canada in Pointe-Claire, QC, for thirty years prior to retiring in 2006. I continue to write, teach, and consult in the pulp and paper industry.

How Foul Condensates are Generated and Treated in a Kraft Pulp Mill

The two key chemicals used in the kraft pulping process are sodium hydroxide (NaOH) and sodium sulfide (Na_2S). In completely ionic form (e.g., Na^+, OH^-, S^{2-}) in aqueous kraft pulping liquor, they delignify wood so that most of the lignin which binds wood fibers together is dissolved, producing individual pulp fibers. Sulfur compounds are an important part of kraft liquor used in pulping and in the chemical recovery processes used to regenerate new cooking liquor (i.e., white liquor) from the black liquor left over after pulping.

The weak black liquor from pulping is separated from the pulp in brownstock washing and concentrated in a multi-effect evaporator system to bring the solids content from about 15-20% to 65-70% (in strong black liquor). The strong liquor is then fired as a fuel in a chemical recovery boiler to produce steam from the dissolved organic contents and smelt from the inorganic contents. The smelt is dissolved in water to produce green liquor (Na_2CO_3 + Na_2S), which is then converted to white liquor (NaOH + Na_2S) via causticizing with calcium hydroxide.

Sulfur-containing compounds are primarily generated in pulping reactions with lignin in wood. Collectively, they are designated as Total Reduced Sulfur (TRS) compounds. They can also be generated in chip pre-steaming before pulping, and are found in the various process liquors undergoing conversion in chemical recovery processes (e.g., evaporation, combustion, causticizing). TRS emissions can occur from pulp washing, liquor storage tanks, and any uncontained kraft liquor if its pH drops significantly below approximately 11.0. Inside a kraft pulp mill, TRS gases are usually referred to as noncondensible gases (NCGs), and there are elaborate and costly systems designed to contain, transport, and destroy them.

There are four chemical components of TRS gases: hydrogen sulfide, methyl sulfide, methyl disulfide, and dimethyl disulfide. The relative concentrations of these components vary with location of emission. If only hydrogen sulfide concentration is measured, it does not provide the complete chemical picture of what is being emitted, and may significantly underestimate the total emissions. The four TRS gases have different odors (all foul), different odor thresholds (all very low), and different toxicities (they can cause serious injury and death).

Typically, a multiple-effect evaporator system is one of the prime sources of TRS gases in a kraft mill. The weak black liquor load to the evaporator plant is directly proportional

to the pulp production rate from the mill's digester. The TRS compounds are removed in "foul condensate" as the black liquor is concentrated prior to burning. If not treated, these gases will vaporize into the ambient atmosphere surrounding the millsite. They are foul-smelling, even at extremely low concentrations in air (e.g., 1 part per billion). Typically, they are removed in gaseous form from the condensate in a steam stripper, and the stripped gases are burned in a dedicated incinerator or in a fuel boiler.

Steam strippers in kraft mills are designed to remove at least 90% of the TRS load (and usually up to 99%) in the foul condensate feed. They are expected to operate continuously, i.e., 99%+ of the mill's operating time. Many steam strippers simultaneously remove methanol from the foul condensate; it is usually condensed, purified, and used elsewhere, reducing the biochemical oxygen demand (BOD) that might otherwise be placed on the mill's wastewater treatment system.

Steam stripping is the standard process for TRS removal from kraft mill foul condensates worldwide and has been for decades. An alternative used infrequently is to send part of the foul condensate flow to a biological wastewater treatment system, where biological digestion and adequate oxidation with air may convert the TRS compounds to innocuous dissolved chemicals. Most wastewater treatment plants are not designed to handle this load. Because there is no containment of off-gases above such a system, unconverted TRS compounds will easily escape into the ambient air and can be carried by the wind for many miles. As a result, allowing the foul condensate to be treated in a biological wastewater system is generally considered a last resort since it relies on a properly operated and maintained treatment system to prevent the TRS gases from escaping.

If there is inadequate steam stripper capacity to handle all of the foul condensate, the prudent response by a kraft pulp mill operator is to reduce pulp production and the related production of foul condensate. In some jurisdictions in North America with which I am familiar (e.g., British Columbia, home to twelve kraft pulp mills), when a steam stripper is shut down and foul condensate storage capacity is full, the multiple-effect evaporator plant and hence the entire mill must be shut down.

New-Indy could immediately and significantly reduce the volumetric rate of foul condensate fed to the steam stripper by decreasing the pulp production rate from the digester, There is a fixed ratio of pulping liquor to virgin wood fed to the digester, so a lower pulp production rate requires less wood and liquor going to the digester and less weak black liquor going from pulping to chemical recovery. In turn, this means that less foul condensate is generated in the evaporator plant.

To compensate at least in part for a lower virgin pulp production rate in the kraft mill, additional linerboard-grade pulp from another source could be used by New-Indy. The obvious source is via the recycling of old corrugated containers (OCC), a common operation in the linerboard industry. This approach is fairly simple and works well technically. The amount of OCC that can be mixed with virgin pulp may be limited by linerboard grade specifications.

THE NEW-INDY FOUL CONDENSATE PROBLEM AND SOLUTION

1. New-Indy has reported in Table 6-1 of its July 12, 2021 Corrective Action Plan that the Aerobic Stabilization Basin (ASB) is emitting 29.44 pounds per hour (or 706.56 pounds per day) of TRS to the ambient air. Of this amount, 2.27 pounds/hr (or 54.48 pounds per day) is reported to be hydrogen sulfide. Therefore, New-Indy reports that the amount of hydrogen sulfide being emitted from the ASB is less than ten percent (10%) of the total of the four malodorous TRS compounds being emitted to the ambient air from the ASB.

2. It is reported by the South Carolina Dept. of Health and Environmental Control (DHEC) that New-Indy's steam stripper can handle only about 400-450 gallons per minute (gpm) of foul condensate of the 800 gpm currently being generated. Therefore, 350-400 gpm of foul condensate is being discharged to the ASB. This amounts to 504,000-576,000 gallons per day of foul condensate that is being discharged untreated to the ASB.

3. The amount of foul condensate generated by the kraft pulp process is roughly proportional to the amount of pulp being produced. Therefore, New-Indy could avoid discharging untreated foul condensate to the ASB (and eliminate this source of emissions to the ambient air) by reducing its pulp production by approximately fifty percent (50%).

4. To my knowledge, it is industry practice for kraft pulp mills that cannot capture, steam strip, and destroy all of their foul condensate stream to curtail or stop pulp production rather than risk releasing TRS to the ambient air.

5. New-Indy could reduce its generation of foul condensate on a temporary or permanent basis by using recycled OCC as part of its linerboard grade pulp fed to the paper machines

6. New-Indy could install and have operational a new steam stripper with adequate capacity to remove virtually all of the TRS compounds from its foul condensate within six (6) months or less.

7. Because a kraft pulp mill such as New-Indy's generates air emissions of all four reduced sulfur compounds that make up TRS, as well as methanol, fence-line and community air monitoring for hydrogen sulfide alone is inadequate to evaluate the source(s) and degree of malodorous and toxic emissions. New-Indy should be monitoring for TRS as well as hydrogen sulfide, methyl mercaptan, and methanol.

Please let me know if you have any questions concerning the above information.

Martin MacLeod, PhD Martin MacLeod

Attachment 25 SEPT 2021

Government Agency & New-Indy Consultant Documents Examined

August 16, 2021: Letter from Renee G. Shealy, South Carolina DHEC to Tony Hobson, VP, New-Indy Catawba LLC., Re: New-Indy Catawba Mill Corrective Action Plan dated July 12, 2021.

June 20, 2021: Letter from Renee G. Shealy, South Carolina DHEC to Tony Hobson, VP, New-Indy Catawba LLC., Re: June 15, 2021 New-Indy Catawba Mill Corrective Action Plan.

June 18, 2021: Pulp Dryer, No. 3 Paper Machine Vents, No. 2 and 3 Smelt Dissolving Tank Vents, and No. 1 and 2 Combination Boilers Emissions Test Plan, New-Indy Catawba LLC, Catawba, South Carolina, prepared by Weston Solutions Inc., Auburn, Alabama.

June 18, 2021: Letter from James E. Justice of South Carolina DHEC to Dan Mallett of New-Indy Catawba LLC Re: Pulp Dryer, No. 3 Paper Machine, No. 2 and 3 Smelt Dissolving Tanks, No. 1 and 2 Combination Boilers, and Steam Stripper Test Plan Submitted June 18, 2021.

June 18, 2021: Letter from David N. Munroe of South Carolina DHEC to Dan Mallett of New-Indy Catawba LLC Re: Steam Stripper, Aerated Stabilization Basin, and Post-Aeration Tank - Test Plan Submitted June 15, 2021.

June 15, 2021: New-Indy Catawba Mill Corrective Action Plan, and DHEC response; June 25, 2021: New-Indy Catawba Mill Corrective Action Plan - Revision 1, and DHEC response; July 12, 2021: New-Indy Catawba Mill Corrective Action Plan - Revision 2, and DHEC response.

April 23, 2021: Letter from Daniel Mallett of New-Indy Catawba LLC to Renee Shealy of the Bureau of Environmental Health Services, Columbia, SC, RE: New-Indy Catawba LLC - Response to DHEC April 9, 2021 York and Lancaster Odor Investigation Letter.

April16, 2021: Letter from Tony Hobson, VP, New-Indy Catawba LLC to Myra Reece of South Carolina DHEC Re: New-Indy Catawba LLC -- Weston Solutions, Inc. Odor Testing Report.

July 23, 2019: South Carolina DHEC Bureau of Air Quality State Construction Permit 2440-0005-DF for New-Indy Catawba LLC, Catawba, SC.

References

Papermaking Science and Technology, Book 6A: Chemical Pulping, J. Gullichsen and C-J. Fogelholm, editors, Fapet Oy, Helsinki, Finland, in co-operation with TAPPI Press, Norcross, GA, 1998, Chapters 2, 3, and 6.
[deals primarily with kraft pulping chemistry and equipment]

Papermaking Science and Technology, Book 6B: Chemical Pulping, J. Gullichsen and C-J. Fogelholm, editors, Fapet Oy, Helsinki, Finland, in co-operation with TAPPI Press, Norcross, GA, 1998, Chapters 11, 12, 13, and 18.
[deals primarily with chemical recovery operations in kraft pulp mills]

Papermaking Science and Technology, Book 19: Environmental Control, P. Hynninen, editor, Fapet Oy, Helsinki, Finland, in co-operation with TAPPI Press, Norcross, GA, 1998, Chapters 6, 7, and 8 and Appendices 1 and 5.
[deals primarily with kraft spent liquor concentration and burning]

Technical Descriptions of the Four TRS Chemical Compounds, Wikipedia, 2021:
https://en.wikipedia.org/wiki/Hydrogen_sulfide
https://en.wikipedia.org/wiki/Methanethiol
https://en.wikipedia.org/wiki/Dimethyl_sulfide
https://en.wikipedia.org/wiki/Dimethyl_disulfide

The Basics of Foul Condensate Stripping, B. Lin, A. H. Lundberg Systems Ltd., Vancouver, Canada, 16 pages (no year given).
[see www.ahlundberg.com/products/wasterwater-treatment/stripping]

Collecting and Burning Noncondensible Gases, B. Lin, A. H. Lundberg Systems Ltd., Vancouver, Canada, 11 pages (no year given).
[see www.ahlundberg.com/products/wasterwater-treatment/stripping]

Atmospheric Emissions of Kraft Pulp Mills, C.M. Bordado and F.P. Gomes, Chemical Engineering & Processing, 41:667 (2002). *[www.elsevier.com/locate/cep]*

Steam Stripping of Kraft Foul Condensates to Reduce TRS and BOD, Q. Pu et al., 1994 TAPPI International Environmental Conference, p.863 (1994).

Collection and Incineration of High Volume - Low Concentration Pulp Mill Noncondensible Gases, D.K. Giarde and M. Crenshaw, 1994 TAPPI International Environmental Conference, p.295 (1994).

A New High Efficiency, Low Cost TRS Scavenging System, F.A. Trauffer, 1994 TAPPI International Environmental Conference, p.979 (1994).