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# ENGINEERING EVALUATION / FACT SHEET

## BACKGROUND INFORMATION

| | |
|---|---|
| Application No.: | R13-2033C |
| Plant ID No.: | 039-00003 |
| Applicant: | Union Carbide Corporation |
| Facility Name: | South Charleston |
| Location: | Kanawha County |
| NAICS Code: | 325199 |
| Application Type: | Modification |
| Received Date: | May 5, 2011 |
| Engineer Assigned: | Steven R. Pursley, PE |
| Fee Amount: | $3,500.00 |
| Date Received: | May 9, 2011 |
| Complete Date: | June 2, 2011 |
| Due Date: | August 31, 2011 |
| Applicant Ad Date: | May 9, 2011 |
| Newspaper: | *The Charleston Daily Mail* |
| UTM's: | Easting: 439.67 km Northing: 4,246.72 km Zone: 17 |
| Description: | Modification to burn process vent gases from the Bayer Material Science Propylene Oxide Filtration System and the Union Carbide Corporation Gum Base Plant in Boiler 26. |

## DESCRIPTION OF PROCESS

Boiler 26 is a natural gas fired boiler that provides steam to plant operations. The boiler will be modified to accommodate process vent gases from the on-site Bayer MaterialScience Plant and Union Carbide Gum Base Plant. The vent gases will be hard piped to Boiler 26.

During cold weather months, condensate is collected from the boiler natural gas feed piping. Collected condensate will be hard-piped to Boiler 26 for burning.

The permit modification would allow Boiler 26 to receive:

* Process vent gas from Bayer's propylene oxide filtering system containing water vapor, nitrogen and propylene oxide.

* Process vent gas from the Gum Base Plant (previously referred to as the Polyvinyl Acetate Plant) containing acetone, isopropanol, vinyl acetate and nitrogen.

* Natural gas liquid condensate from boiler fuel feed piping.

The heat input from process vent gas combustion will be less than 10% of the total annual heat input to the boiler.

As discussed below, in order to implement these changes and still avoid PSD applicability Union Carbide must permanently shut down the existing coal fired boiler (Boiler 25). Following commencement of the proposed activities, steam for the South Charleston facility will be provided by Boilers 26 and 27. No later than the day before commencement of operation of the proposed activities, Boiler 25 will be permanently shut down. To demonstrate that Boiler 25 operations are permanently shut down, positive isolation devices will be installed on fuel feeds and boiler cycle water piping.

## SITE INSPECTION

Since this is a minor modification to a well known existing source no site inspection was performed. A full site inspection was performed by Todd Shrewsbury of DAQ's enforcement section on September 30, 2010. The facility was found to be in compliance.

## ESTIMATE OF EMISSIONS BY REVIEWING ENGINEER

Boiler 26's existing PTE is as follows:

| **Pollutant** | **Potential Emissions (pounds/hour)** | **Potential Emissions (tons/year)** |
|---|---|---|
| Carbon Monoxide (CO) | 22.5 | 98.37 |
| Oxides of Nitrogen ($NO_x$) | 24.64 | 109.17 |
| Particulate Matter (PM) | 1.76 | 7.72 |
| Sulfur Dioxide ($SO_2$) | 0.21 | 0.91 |
| Total Organic Compounds (TOC) | 0.49 | 2.13 |

Boiler 26's new PTE will be as follows:

| Pollutant | Potential Emissions (pounds/hour) | Potential Emissions (tons/year) |
|---|---|---|
| Carbon Monoxide (CO) | 22.5 | 98.4 |
| Oxides of Nitrogen ($NO_x$) | 70.4 | 308.35 |
| Particulate Matter (PM)* | 2.22 | 9.7 |
| Sulfur Dioxide ($SO_2$) | 20.1 | 88.1 |
| Total VOC's | 24.2 | 13.1 |
| Vinyls Acetate | 0.82 | 1.1 |
| Propylene Oxide | 20 | 0.6 |
| Hexane | 1.4 | 2.8 |
| Total HAPs | 22.3 | 4.6 |
| $CO_{2e}$ | 43,370 | 186,301 |

* All PM is assumed to be $PM_{2.5}$ and includes condensables.

The potential to emit (PTE) from this boiler exceeds the significance thresholds of 45CSR14 &19. Therefore, in order to avoid review under PSD/NSR the applicant must "net out". The netting process is detailed under the "Regulatory Applicability section of this evaluation."

Additionally, there will be fugitive emissions resulting from the piping of the vent gasses and natural gas condensate. Total fugitive emissions will be 0.91 pounds per hour and 1.54 tons per year of VOC's of which 0.33 pounds per hour and 1.13 tons per year will be HAPs. Therefore the total new PTE of the facility covered under this permit will be as follows:

| Pollutant | Potential Emissions (pounds/hour) | Potential Emissions (tons/year) |
|---|---|---|
| Carbon Monoxide (CO) | 22.5 | 98.4 |
| Oxides of Nitrogen ($NO_x$) | 70.4 | 308.35 |
| Particulate Matter (PM) | 2.22 | 9.7 |
| Sulfur Dioxide ($SO_2$) | 20.1 | 88.1 |
| Total VOC's | 25.1 | 14.64 |
| Vinyls Acetate | 0.92 | 1.53 |
| Propylene Oxide | 20.16 | 1.28 |
| Hexane | 1.47 | 2.81 |
| Total HAPs | 22.63 | 5.73 |
| $CO_{2e}$ | 43,370 | 186,301 |

Therefore, the increase in PTE from the facility covered under this permit will be as follows:

| Pollutant | Potential Emissions (pounds/hour) | Potential Emissions (tons/year) |
|---|---|---|
| Carbon Monoxide (CO) | 0 | 0 |
| Oxides of Nitrogen ($NO_x$) | 45.92 | 199.18 |
| Particulate Matter (PM) | 0.46 | 1.98 |
| Sulfur Dioxide ($SO_2$) | 19.89 | 87.19 |
| Total VOC's | 24.61 | 12.51 |
| Vinyls Acetate | 0.92 | 1.53 |
| Propylene Oxide | 20.16 | 1.28 |
| Hexane | 1.47 | 2.81 |
| Total HAPs | 22.63 | 5.73 |
| $CO_{2e}$ | 43,370 | 186,301 |

REGULATORY APPLICABILITY

The facility proposed to be permitted under this application R13-2033C is subject to the following state regulations:

STATE RULES

45CSR2 To Prevent and Control Particulate Air Pollution from Combustion of Fuel in Indirect Heat Exchangers.

Per §45-2-3.1 visible emission from the source shall not exceed 10% opacity based on a six minute block average. Because the boiler will use only natural gas, with small amounts of process gas and natural gas condensate, this requirement should be met.

§45-2-4.1.b limits the amount of PM released into the air from the boiler to 31.68 pounds per hour (based on a maximum heat input of 352 mmbtu/hr). Permitted emissions of PM from the boiler will be 2.22 pounds per hour. Therefore this requirement should be met.

45CSR10 To Prevent and Control Air Pollution from the Emission of Sulfur Oxides.

§45-10-3.2.c limits the amount of $SO_2$ emitted from the boiler to 563.2 pounds per hour. Permitted emissions of $SO_2$ from the boiler will be 20.1 pounds per hour. Therefore this requirement should be met.

45CSR13 Permits for Construction, Modification, Relocation and Operation of Stationary Sources of Air Pollutants, Notification Requirements, Temporary Permits, General Permits, and Procedures for Evaluation.

The source is subject to 45CSR13 because the emission rates of several pollutants will increase by more than 6 pounds per hour and 10 tons per year.

45CSR16 Standards of Performance for New Stationary Sources.

The source is subject to 45CSR16 because it is subject to 40 CFR 60 Subpart Db.

45CSR27 To Prevent and Control the Emissions of Toxic Air Pollutants

The boiler will only emit TAPs in quantities significant enough to trigger rule 27 when burning process vent gas from Bayer Materialscience. While burning this process vent gas

the boiler will be subject to 40 CFR 63 Subpart PPP. Per 45 CSR 27.3.1, equipment subject to a federal regulation or standard shall not be required to comply with provisions more stringent than such regulation or standard. Therefore, UCC shall comply with 45CSR27 by complying with 40 CFR 63 Subpart PPP.

It should be noted that since the process vent gas is coming from a different facility it is questionable, in the writers opinion, whether the boiler should be considered part of the polyether polyol manufacturing process unit (PMPU) that would be subject to this MACT. However, even if it is not subject, the requirements of Subpart PPP would be used as a suitable application of BAT as required under Rule 27.

45CSR30 Requirements for Operating Permits.

The source is subject to 45CSR30 because it is a major stationary source and is also subject to 40 CFR 60 Subpart Db and 40 CFR 63 Subpart PPP.

45CSR34 Emissions Standards for Hazardous Air Pollutants

The source is subject to 45CSR34 because, when burning process vent gas from Bayer Materialscience, it is subject to 40 CFR 63 Subpart PPP. Additionally, when combusting process vent gas from the UCC Gum Base Plant, the boiler will be subject to 40 CFR 63 Subpart FFFF (MON MACT).

FEDERAL REGULATIONS:

40 CFR 60 Subpart Db: Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units.

The boiler is subject to Subpart Db because it is a steam generating unit that commenced construction, modification, or reconstruction after June 19, 1984, and has a heat input capacity from fuels combusted in the steam generating unit of greater than 29 megawatts (MW) (100 million British thermal units per hour (MMBtu/hr)).

The main requirement of Subpart Db that is applicable to this boiler is the $NO_x$ limit. 60.44b(1)(ii) limits the $NO_x$ emissions from the boiler to 0.20 pounds per mmbtu. For Boiler 26 this equates to a limit of 70.4 pounds per hour. This is the limit UCC has proposed. Additionally, 60.48b(b) requires the installation of a $NO_x$ Continuous Emissions Monitoring System (CEMS).

40 CFR 63 Subpart PPP: National Emissions Standards for Hazardous Air Pollutants: Polyether Polyol Production.

The boiler will be subject to Subpart PPP when burning process vent gas from Bayer Materialscience. The main requirement of Subpart PPP applicable to Boiler 26 is to control emissions to a level set in 63.1425(b)(2). This requirement gives three options to comply. UCC has stated that it will comply with the requirement by reducing emissions of propylene oxide by at least 98%.

Since the boiler is over 44 MW (approximately 150 mmbtu/hr) it is exempt from many of the monitoring requirements of the rule.

40 CFR 63 Subpart FFFF: National Emissions Standards for Hazardous Air Pollutants: Miscellaneous Organic Chemical Manufacturing.

The boiler will be subject to Subpart FFFF when burning process vent gas from the UCC Gum Base plant. The main requirement of Subpart FFFF applicable to Boiler 26 is to control emissions to a level set in 63.2455(a). This requirement gives three options to comply. UCC has stated that it will comply with the requirement by reducing emissions of vinyl acetate by at least 98%.

NON-APPLICABILITY DETERMINATIONS

The modification of the boiler is not subject to 45CSR14 nor 45CSR19 because, as shown below, UCC has netted out of PSD/NSR review. Note that Kanawha county is a nonattainment area for $PM_{2.5}$ and both $NO_x$ and $SO_2$ are treated as precursors for $PM_{2.5}$. Therefore the netting for those two pollutants is actually performed per 45CSR19 while the netting for $CO_{2e}$ is performed under 45CSR14. However, there is no substantive differences in the methodologies for this particular case.

Significance levels under PSD/NSR are as follows:

| Pollutant | tons/year |
|---|---|
| Carbon Monoxide (CO) | 100 |
| Oxides of Nitrogen ($NO_x$) | 40 |
| Particulate Matter (PM) | 25 |
| $PM_{10}$ | 15 |
| $PM_{2.5}$ | 10 |
| Sulfur Dioxide ($SO_2$) | 40 |
| Ozone (VOC) | 40 |
| $CO_{2e}$ | 75,000 |

Future potential emissions from the activities covered under this permit will be as follows:

| Pollutant | Potential Emissions (tons/year) |
|---|---|
| Carbon Monoxide (CO) | 98.4 |
| Oxides of Nitrogen ($NO_x$) | 308.35 |
| Particulate Matter (PM)* | 9.7 |
| Sulfur Dioxide ($SO_2$) | 88.1 |
| Total VOC's | 14.64 |
| $CO_{2e}$ | 186,301 |

*All PM is conservatively assumed to be $PM_{2.5}$

As can be seen from the above table, emissions of $NO_x$, $SO_2$, and $CO_{2e}$ are above the significance levels.

Boiler 26's past actual emissions (based on 2 year average from calendar years 2006/2007) are as follows:

| Pollutant | Past Actual Emissions (tons/year) |
|---|---|
| Oxides of Nitrogen ($NO_x$) | 12 |
| Sulfur Dioxide ($SO_2$) | 0 |
| $CO_{2e}$ | 17,593 |

Therefore the increases (past actuals to future potentials) from the modification are as follows:

| Pollutant | Increase in Emissions (tons/year) |
|---|---|
| Oxides of Nitrogen ($NO_x$) | 296.35 |
| Sulfur Dioxide ($SO_2$) | 88.1 |
| $CO_{2e}$ | 168, 708 |

Since the increases in $NO_x$, $SO_2$, and $CO_{2e}$ are still above the significance levels a full netting analysis must be performed.

The applicant has stated that "There were no projects implemented during the 5-year look-back period (2006-2010) that resulted in increased criteria pollutant emissions or greenhouse gases." Additionally, the applicant has agreed to permanently shut down an existing coal fired boiler (Boiler 25 can actually be fired with either coal or natural gas but has been fired primarily with coal) in order to be able to net out of Rules 14 & 19. Past actual emissions from Boiler 25 (based on an average of 2006 and 2007 calendar years) are as follows:

| Pollutant | Boiler 25 Past Actual Emissions (tons/year) |
|---|---|
| Oxides of Nitrogen ($NO_x$) | 463 |
| Sulfur Dioxide ($SO_2$) | 981 |
| $CO_{2e}$ | 187,637 |

Therefore the total net change in emissions will be as follows:

| Pollutant | Net Emissions Change (tons/year) |
|---|---|
| Oxides of Nitrogen ($NO_x$) | -166.65 |
| Sulfur Dioxide ($SO_2$) | -892.9 |
| $CO_{2e}$ | -18,929 |

As can be seen from the preceding table, since there will be a net reduction in emissions of $NO_x$, $SO_2$, and $CO_{2e}$, PSD/NSR review is not triggered.

TOXICITY OF NON-CRITERIA REGULATED POLLUTANTS

The following information was obtained from USEPA's Air Toxic Website.

**Vinyl Acetate** - HAP

Vinyl acetate is primarily used as a monomer in the production of polyvinyl acetate and polyvinyl alcohol. Acute (short-term) inhalation exposure of workers to

vinyl acetate has resulted in eye irritation and upper respiratory tract irritation. Chronic (long-term) occupational exposure did not result in any severe adverse effects in workers; some instances of upper respiratory tract irritation, cough, and/or hoarseness were reported. Nasal epithelial lesions and irritation and inflammation of the respiratory tract were observed in mice and rats chronically exposed by inhalation. No information is available on the reproductive, developmental, or carcinogenic effects of vinyl acetate in humans. An increased incidence of nasal cavity tumors has been observed in rats exposed by inhalation. In one drinking water study, an increased incidence of tumors was reported in rats. EPA has not classified vinyl acetate for carcinogenicity.

**Propylene Oxide** - TAP/HAP

Propylene oxide is used in the production of polyethers (the primary component of polyurethane foams) and propylene glycol. Acute (short-term) exposure of humans and animals to propylene oxide has caused eye and respiratory tract irritation. Dermal contact, even with dilute solutions, has caused skin irritation and necrosis in humans. Propylene oxide is also a mild central nervous system (CNS) depressant in humans. Inflammatory lesions of the nasal cavity, trachea, and lungs and neurological effects have been observed in animals chronically (long-term) exposed to propylene oxide by inhalation. Propylene oxide has been observed to cause tumors at or near the site of administration in rodents, causing forestomach tumors following ingestion via gavage (experimentally placing the chemical in the stomach) and nasal tumors after inhalation exposure. EPA has classified propylene oxide as a Group B2, probable human carcinogen.

## AIR QUALITY IMPACT ANALYSIS

Since this is a minor modification to an existing major stationary source as defined in 45CSR14, no modeling was performed.

## MONITORING OF OPERATIONS

In addition to the monitoring required by 40 CFR 60 Subpart Db, 40 CFR 63 Subparts PPP and FFFF, the permittee shall record the amount of natural gas, natural gas condensate, and process vent gas consumed by the boiler.

CHANGES TO PERMIT R13-2033B

Changes made to the permit are significant enough that R13-2033C is essentially a brand new permit.

RECOMMENDATION TO DIRECTOR

Information supplied in the application indicates that compliance with all applicable regulations will be achieved. Therefore it is the recommendation of the writer that permit R13-2033C for the modification of a boiler in South Charleston, Kanawha County, be granted to Union Carbide Corporation.

Steven R. Pursley, PE
Engineer

July 21, 2011