

CHATTANOOGA-HAMILTON COUNTY AIR POLLUTION CONTROL BUREAU

Statement of Basis Part 70 Permit No. 47-065-5345

Sofix LLC
2800 Riverport Road
Chattanooga, Tennessee 37406-1702
Telephone: 423.624.3500
Contacts: Sean Reynolds – ext. 106
Anthony Paolucci – ext. 104
Paul Cahill – ext. 200

J. Alan Frazier
Engineering Manager
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Emission Unit No.	Description
001	Color Former Production Process
002	Product Recovery and Solvent Purification Process
003	Product Handling Process
004	Wastewater Air-Stripping System
005	Cleaver-Brooks Boiler
006	Clarke Emergency Fire-Suppression Pump Engine

Purpose

Sofix LLC has applied for the renewal of their Part 70 (Title V) permit. This company name is registered as an active entity with the Tennessee Secretary of State. This statement of basis includes discussions of the operation of the permitted equipment, the air pollutant emissions, and the applicable regulations. It has been adapted from the Bureau inspection report for Sofix dated January 9, 2023.

Process Description

The sole product that is produced by Sofix at this plant is an organic chemical dye that is known as “color former.” Color former is a white powder that is used to coat pressure-sensitive carbonless duplication paper and thermal-sensitive facsimile paper. It is made in four slightly different versions that are designated as S-205, Bk-305, Bk-400, and ETAC. The molecular formula of S-205, which is the most commonly produced version of color former, is $C_{34}H_{34}N_2O_3$. Color former is made from two intermediate chemicals that are referred to as ACME and BCA, and each of the three varieties of color former requires a different form of BCA. Perchloroethylene (tetrachloroethene, $Cl_2C=CCl_2$) was used as the carrier solvent in the color former production process (**Emission Unit 001**) from the time of initial plant start-up in 1992 through August 2001. This solvent was changed to toluene (methylbenzene, $C_6H_5CH_3$) in September 2001.

The color former production process is a batch operation that consists of a series of eight processing steps that are referred to as the “C-Line.” Each step requires from ten to twelve hours (one shift), and the total batch retention time in the entire process is about four days, if operation is continuous. A new batch can be initiated each shift, and up to eight batches may be in progress simultaneously, each in a different step of the process. The first step is the initial reaction in which the two intermediate chemicals are mixed with a 98% aqueous solution of sulfuric acid (H_2SO_4) in any of three reactor vessels. Trace emissions of sulfuric acid from each reactor are controlled by a scrubber that uses water as the scrubbing medium. The sulfuric acid solution is supplied from Storage Tank 4523, which has a capacity of 11,000 gallons, and trace uncontrolled emissions of sulfuric acid from this tank occur as both working losses and standing storage losses.

The chemical intermediates are dry powders that are received in bulk bags and are introduced into any of the reactors through a sealed connection. As the intermediates are poured into the reactor, displaced air from the reactor is vented to a baghouse for the control of particulate matter. The baghouse exhausts to the inside of a building so that no particulate matter is emitted from it to the outside. The reactor charging operation is therefore not required to be permitted.

In the second step, the contents of any of the three reactors are diluted with water and a 7% aqueous solution of sulfuric acid from Storage Tank 3125. The diluted material is then filtered. Trace emissions of sulfuric acid from the dilution and filtration vessels are controlled by the scrubber, and negligible emissions of sulfuric acid from Tank 3125 are uncontrolled.

The filter cake is neutralized with water and a 48% aqueous solution of sodium hydroxide (caustic, NaOH) in the third step of the process. This material is then introduced, along with toluene (methylbenzene, $C_6H_5CH_3$) and aqueous 48% sodium hydroxide solution, into a reactor of the fourth processing step where the crude product is formed by a “ring closure” reaction. The toluene is used as a carrier solvent. The product, in solution with toluene, is then phase separated from the aqueous sodium hydroxide solution. The sodium hydroxide solution for the third and fourth steps is supplied from Storage Tank 4521, which has a 6,000-gallon capacity. Negligible emissions of sodium hydroxide from the third and fourth processing steps and from Tank 4521 are uncontrolled. The toluene for the fourth step is supplied from Storage Tank 3211B.

The product, dissolved in toluene solvent, is filtered in the fifth processing step. Clay and diatomaceous earth are added to the product to aid in the filtration. The filtrate is cooled and crystallized in the sixth step. The resulting slurry is then filtered with toluene from Storage Tank 3211B in the seventh step of the process. The moist product, in the form of filter cake, is discharged into portable storage bins. Filtered toluene from the sixth and seventh steps is sent to Storage Tank 3215A, 3215B, or 3215C, with each of these tanks being dedicated for receiving toluene that results from the production of a different version of color former. The capacity of each of these three tanks is 4,000 gallons.

The product is unloaded from the bins into either of two steam-heated conical dryers for drying in the eighth processing step. One of these dryers is older and slightly smaller. It is not normally used, but it is available for use as a backup unit. Particulate emissions of color former

product from each of the two product dryers are controlled by a baghouse that is an integral component of the dryer. Product that is collected by either baghouse is returned to the dryer for that baghouse.

Virgin Tank 4210 is used to initially store toluene that is delivered to the plant in order to replace solvent that is lost through emissions to the atmosphere and in waste streams. This storage tank is loaded from tank trucks, and it supplies toluene to Storage Tank 3211A. Storage Tanks 3211A and 3211B are connected together so that a common level is maintained in them. Each of these three tanks has a capacity of 7,900 gallons.

VOC emissions of toluene result from the various process vessels of the fourth through eighth steps of the color former production process. Each of the vessels of the fourth through seventh processing steps and the baghouse of either of the two product dryers (the eighth process step) is initially vented to a shell-and-tube condenser, and the uncondensed vapors are vented, by way of a common header, to a dual refrigerated-condenser unit followed by a dual-bed carbon adsorption unit for the control of VOC emissions of toluene. Additional control for the particulate emissions from either dryer is provided by a cyclonic knockout drum that precedes the header. The refrigerated condenser unit operates at a temperature of about -80°F, and the two condensers of this unit are cycled so that one is put into operation when the other one begins to be defrosted. The two carbon beds of the adsorption unit are also cycled so that one begins operation while regeneration with steam commences in the other one. Toluene that is recovered by both the refrigerated condenser unit and the carbon adsorption unit is ultimately purified for reuse.

VOC emissions of toluene, in the form of both working losses and standing storage losses, result from Storage Tanks 4210, 3211A, 3211B, 3215A, 3215B, and 3215C. Each of these tanks is equipped with a conservation vent that serves to minimize the standing storage losses. During regeneration of either of the two beds of the carbon adsorption unit, the toluene-laden steam is sent to Decanter 3213, which has a capacity of 3,200 gallons. The decanted water that results is sent to Storage Tank 3217. VOC emissions of toluene occur as standing storage losses from the decanter and are negligible from Tank 3217. The VOC emissions of toluene from the seven tanks and decanter are controlled by the refrigerated condenser unit followed by the carbon adsorption unit.

The filtrate from the second (dilution and filtration) step of the color former production process is an aqueous 28% sulfuric acid solution that is purified by filtration in a batch process that is referred to as the "X-Line." Most of this sulfuric acid solution is sold after it has been purified since it is not of a suitable concentration to be reused in the color former production process. Some of this purified sulfuric acid, however, is used to neutralize both a 35% aqueous solution of sodium hydroxide that is separated from the crude product during the fourth (ring closure and separation) processing step and the filter cake residue from the fifth (filtration) processing step. The neutralized solution is filtered in a filter press, and the resulting filter cake residue is a waste material that is disposed of off-site. Negligible emissions of sulfuric acid and sodium hydroxide from the process vessels and tanks of the X-Line are not controlled.

All of the toluene solvent in the plant is continuously reused in the color former production process. Impurities are removed from the toluene by treating it in a product recovery and solvent purification process (**Emission Unit 002**). This semi-batch process begins with the distillation of the filtered toluene from Storage Tanks 3215A, 3215B, and 3215C in a product recovery still. Purified toluene that results from this still is sent to Storage Tank 3211A.

The remaining solution from the product recovery still, condensed toluene that is recovered from the refrigerated condenser unit, and condensed toluene that is recovered from the condenser that follows the two product dryer baghouses are passed through a filter. The resulting filter cake is crude product that is reintroduced into the color former production process at the third (neutralization) step. The resulting filtrate and toluene that is separated from water in Decanter 3213 are then distilled in a solvent recovery still. The resulting distilled solution is then sent to the product recovery still. VOC emissions of toluene from the various process vessels of the product recovery and solvent purification process are controlled by the refrigerated condenser unit followed by the carbon adsorption unit.

Undistilled residue that remains in the bottom of the solvent recovery still is a waste material. It is removed from the still periodically and loaded into drums for off-site disposal. Trace VOC emissions of toluene and other organics that result from drum loading are controlled by the scrubber.

Fugitive VOC emissions of toluene result from applicable valves, pumps, agitators, and connectors of the color former production process and product recovery and solvent purification process. All of these components are monitored periodically to detect leaks of toluene and are repaired, if necessary, in accordance with a leak detection and repair (LDAR) program. No fugitive emissions are considered to result from valves and connectors that are in gas service and that are associated with any of the process vessels that are under negative pressure.

After the color former product has been dried, it is pneumatically conveyed to a product handling process (**Emission Unit 003**). In this process, the powdered material is initially stored in any of three silos. The product is next pneumatically conveyed to a blending silo. Air is pulsed up through the product in this silo in order to blend it. Either of two filling machines is then used to load the color former product into paper bags, bulk bags, or fiber drums.

Particulate emissions of color former product from the three product storage silos are controlled by a single baghouse, and product that is collected by this baghouse is dropped into one of the silos. Particulate emissions of color former product from the blending silo are controlled by a baghouse that is an integral component of this silo, and collected product falls into the silo. A cyclone followed by a cartridge filter is used to control particulate emissions of color former product from the two filling machines, and product that is collected by the cyclone and filter is recycled. The filter has no exhaust aperture and is not directly vented to the outside, but it is adjacent to an exterior door.

Wastewater that is generated by the plant and rainwater runoff contain trace amounts of toluene that are removed from the water by an air-stripping system (**Emission Unit 004**). This system consists of two air-stripping columns in series. VOC emissions of toluene from these two columns are uncontrolled. The major sources of the wastewater are filtrate from the filter press of the X-Line and used water from the scrubber.

Process steam for the plant is provided by a Cleaver-Brooks boiler (**Emission Unit 005**) that is fueled exclusively by natural gas. Emissions that result from fuel combustion in the boiler are uncontrolled.

A new Clarke emergency engine is available to power a water pump for use in fire suppression in the event of a power loss. This internal-combustion engine is fueled exclusively by ultra-low sulfur diesel fuel (No. 2 fuel oil). It is operated periodically for test purposes, and uncontrolled emissions result from fuel combustion in it.

Evaluation

SCREEN modeling (assuming flat terrain and no building downwash) of the particulate emissions from this plant that are allowed by Rule 10 results in an ambient concentration of 29.27 $\mu\text{g}/\text{m}^3$ (24 hr avg.) at the closest point on the former particulate non-attainment area. According to §4-8(e)(2)f of the Ordinance, particulate emissions from a plant significantly impact on the air quality within the former particulate non-attainment area when these emissions result in an ambient concentration that exceeds 5 $\mu\text{g}/\text{m}^3$ (24 hr avg.) at the former non-attainment area boundary. Therefore, the various particulate emissions sources at this plant, which was constructed in 1991, are subject to BACT [§4-8(e)(2)]. The various VOC emission sources and process gaseous emission sources at this plant are subject to BACT (Rule 25.3) and Rule 23, respectively.

The plant is subject to “National Emission Standards for Hazardous Air Pollutants: Miscellaneous Organic Chemical Manufacturing,” [40 CFR Part 63, Subpart FFFF (§63.2430–63.2550)], as adopted at Rule 16.5(c). §63.2460 of Subpart FFFF stipulates that the collective VOC emissions of toluene from process vents be reduced by at least 95% by being vented to any combination of recovery devices. §63.2480 of this subpart requires that applicable valves, pumps, agitators, and connectors be monitored periodically to detect leaks of toluene and be repaired, if necessary. In addition, §63.2490 of this subpart requires that applicable cooling-water heat exchange systems be monitored periodically to detect leaks of toluene into the water and be repaired, if necessary. Reporting and recordkeeping requirements are given in §63.2520 and §63.2525, respectively, of this subpart.

Emission Unit 001 Color Former Production Process
Emission Unit 002 Product Recovery and Solvent Purification Process

New batches can be started in the color former production process at a minimum of about one every 12 hours, and several batches are usually at various stages in the process at any one time.

The product recovery and solvent purification process is typically operated whenever the color former production process is in operation. The two processes can be operated independently, however. 380 batches were completed in the production process during the twelve-month period from September 1, 2020, through August 31, 2021, which corresponds to non-negligible venting of emissions from the process vessels for about 4,560 hr (380×12 hr) during this period.

It was determined by an emissions test that was conducted on January 19, 1993, that the former emissions of perchloroethylene, before being controlled, averaged 70.597 lb/hr for the portion of that day's operation during which more than trace emissions occurred. It is estimated that the uncontrolled VOC emissions of toluene should be approximately 86.080% of these emissions of perchloroethylene, based solely on differences in vapor pressure and molecular weight. Based on an average toluene exhaust concentration of 6 ppm and on the average exhaust flow rate that was measured during the emissions test, the refrigerated condenser unit and carbon adsorption unit combined are estimated to be 99.658% efficient in controlling VOC emissions of toluene.

The estimated VOC emissions of toluene from the combined sources that are controlled by the carbon adsorption unit are given in Table IV at the end of this section. The potential emissions are based on continuous operation at the maximum rate of one new batch every 12 hours and on the maximum toluene exhaust concentration of 50 ppm.

Control of the VOC emissions of toluene from the process vessels, toluene storage tanks, and decanter of the color former production process and from the process vessels of the product recovery and solvent purification process by carbon adsorption has been determined to be BACT (Rule 25.3). An appropriate BACT limitation for the VOC emissions of toluene from the combined sources that are controlled by the carbon adsorption unit has been previously determined to be 2.0 lb/hr. In addition, an appropriate BACT limitation for the fugitive VOC emissions of toluene from the valves, pumps, agitators, and connectors combined at the facility has been previously determined to be 16.0 tons/yr.

The particulate emissions of color former product from the baghouse of either product dryer are stated by the baghouse manufacturer to be no greater than 0.02 gr/scf. Each of these baghouses has an estimated particulate control efficiency of 99.95%. Any additional particulate control efficiency that is provided by the knockout drum has not been estimated. Either dryer is assumed to be in operation for about 12 hours per batch. The estimated particulate emissions from the larger dryer are given in Table V at the end of this section. The potential emissions are based on continuous operation at the maximum rate of one new batch every 12 hours.

Control of the particulate emissions from each of the two product dryers by a baghouse has been determined to be BACT [§4-8(e)(2)]. An appropriate BACT limitation for the particulate emissions from each of these two dryers has been previously determined to be 0.020 gr/scf, which is equivalent to 0.014 lb/hr at the reported baghouse flow rate of 80 cfm for the larger dryer and 0.010 lb/hr at the reported baghouse flow rate of 56 cfm for the smaller dryer. Each of these limitations is more stringent than both the Rule 10.3 (Schedule 2) particulate emission limit of 3.81

lb/hr, based on a process weight of 2,200 lb/hr for either dryer, and the Rule 10.7 particulate emission limit of 0.25 gr/scf, which is equivalent to 0.17 lb/hr at the baghouse flow rate for the larger dryer and 0.12 lb/hr at the baghouse flow rate for the smaller dryer. The actual exhaust for both baghouses is the exhaust stack of the carbon adsorption unit.

The scrubber is estimated to be 99% efficient in controlling the trace emissions of sulfuric acid that are vented from the reactors and from the dilution and filtration vessels of the color former production process. These estimated sulfuric acid emissions are given below in Table I. The potential emissions are based on continuous venting of emissions from the process vessels. The estimated trace emissions of sulfuric acid from Storage Tank 4523 are also given in Table I. These emissions were estimated by using AP-42 equations. The potential emissions are conservatively based on continuous filling of the tank.

Table I. Emissions of Sulfuric Acid from the Color Former Production Process

Emission Source	Actual Emissions <i>tons/yr</i>	Potential Emissions		Allowable Emissions <i>lb/hr</i>
		<i>lb/hr</i>	<i>tons/yr</i>	
Color Former Process Vessels	0.000024	0.000011	0.000047	0.01
Storage Tank 4523	0.0000041	0.0000045	0.000020	
Total Sulfuric Acid	0.000028	0.000015	0.000067	0.01

Control of the emissions of sulfuric acid from the reactors and from the dilution and filtration vessels of the color former production process by a scrubber has been determined to be reasonable and proper, in accordance with Rule 23. An appropriate reasonable and proper limitation for the plant-wide emissions of sulfuric acid has been previously determined to be 0.01 lb/hr. No controls for the sulfuric acid emissions from Storage Tank 4523 are necessary in order to achieve this limitation.

The scrubber is estimated to be 99% efficient in controlling the VOC emissions of toluene and other organics that result from filling of drums with residue. These trace emissions have not been quantified. Control of these VOC emissions by a scrubber has been determined to be BACT, and no quantitative BACT emission limitation is necessary.

Emission Unit 003 Product Handling Process

The particulate emissions of color former product from both of the baghouses of the product handling process are stated by the baghouse manufacturer to be no greater than 0.02 gr/scf. The particulate control efficiency of each of these baghouses is estimated to be 99.95%. The cyclone followed by the cartridge filter also results in particulate emissions of color former product of no more than 0.02 gr/scf and has an estimated particulate control efficiency of 99.95%. Filling

of the three storage silos occurs for approximately 1 hour per batch of the color former production process at an exhaust flow rate of 400 cfm. Filling of the blending silo occurs for about 1 hour per batch at an exhaust flow rate of 480 cfm. Blending of product by pulses of air in the blending silo occurs for about 1 hour per every two batches. These air pulses result in an average exhaust flow rate of about 200 cfm. Filling of product into drums or bags by way of the two filling machines occurs for approximately 4 hours per batch at an exhaust flow rate of 200 cfm. 380 batches were completed in the color former production process during the twelve-month period from September 1, 2020, through August 31, 2021.

The estimated particulate emissions from the storage silos, blending silo, and filling machines are given in Table V. The potential emissions are based on continuous operation at the maximum rate of one new batch of the color former production process every 12 hours, with blending occurring for 11 hours per batch (whenever the blending silo is not being filled).

Control of the particulate emissions from the three product storage silos by a baghouse has been determined to be BACT [§4-8(e)(2)]. An appropriate BACT limitation for these particulate emissions has been previously determined to be 0.020 gr/scf, which is equivalent to 0.069 lb/hr for the reported baghouse exhaust flow rate of 400 cfm. This limitation is more stringent than the Rule 10.7 particulate emission limit of 0.25 gr/scf (0.86 lb/hr).

Control of the particulate emissions from the blending silo by a baghouse has also been determined to be BACT. An appropriate BACT limitation for these particulate emissions has been previously determined to be 0.020 gr/scf, which is equivalent to 0.082 lb/hr for the maximum reported baghouse exhaust flow rate of 480 cfm. This limitation is more stringent than the Rule 10.7 particulate emission limit of 0.25 gr/scf (1.03 lb/hr).

In addition, control of the particulate emissions from the two filling machines by a cyclone followed by a cartridge filter has been determined to be BACT. An appropriate BACT limitation for these particulate emissions has been previously determined to be 0.020 gr/scf, which is equivalent to 0.034 lb/hr for the reported filter exhaust flow rate of 200 cfm. This limitation is more stringent than the Rule 10.7 particulate emission limit of 0.25 gr/scf (0.43 lb/hr). The sum of the three BACT limitations for the storages silos, blending silo, and filling machines is more stringent than the Rule 10.3 (Schedule 2) particulate emission limit of 5.65 lb/hr, based on a process weight of 4,160 lb/hr.

Emission Unit 004 Wastewater Air-Stripping System

Wastewater can be treated in the air-stripping system at a maximum rate of 1,800 gal/hr. The toluene removal efficiency of the combined primary and secondary air-stripping columns of this system is considered to be close to the estimated perchloroethylene removal efficiency for the combined columns of 99.965%. 3,506,006 gallons of wastewater with an average toluene concentration of 0.698 mg/l (0.699 ppm) were treated in the air-stripping system from September 1, 2020, through August 31, 2021.

The estimated VOC emissions of toluene from the wastewater air-stripping system are given in Table IV. The potential emissions are based on continuous treatment of wastewater with a toluene concentration of 60 ppm at the maximum treatment rate. **Actual VOC emissions of toluene from the air-stripping system are estimated to be 0.010 ton/yr.**

An appropriate BACT (Rule 25.3) limitation for the concentration of toluene in the wastewater that is to be processed in the air-stripping system has been previously determined to be 60 ppm. This limitation is more stringent than the threshold of 1,000 ppm for Group 1 wastewater streams that is found in §63.2485(c)(2) of 40 CFR Part 63, Subpart FFFF. In addition, an appropriate BACT limitation for the rate at which wastewater is processed in this system has been previously determined to be 1,800 gal/hr. Assuming that all of the toluene in the wastewater is emitted into the air, the toluene concentration and process rate limitations result in an appropriate BACT limitation for the VOC emissions of toluene from the wastewater air-stripping system of 0.90 lb/hr. No controls are necessary in order to achieve this limitation.

Emission Unit 005 Cleaver-Brooks Boiler

The Cleaver-Brooks boiler has a rated capacity of 12.553 MMBtu/hr. 25,713.1 MMBtu of natural gas were burned in it during calendar year 2021.

The estimated emissions of particulate, NO_x, CO, VOCs, SO₂, and GHGs (actual and CO₂e) that result from natural gas combustion in the boiler are given in Table II, which follows. These emissions, with the exception of emissions of GHGs, were calculated by using AP-42 (1998) emission factors. The GHG emissions were calculated by using the Tier 1 calculation methodology that is found in §98.33 of 40 CFR Part 98, Subpart C. The potential emissions are based on continuous operation of the boiler at its rated capacity. All of the particulate emissions that result from burning natural gas are both PM_{2.5} and PM₁₀. According to AP-42 (1998) emission factors, VOC emissions that result from natural gas combustion consist of 32.7% hexane [CH₃(CH₂)₄CH₃] and 1.5% formaldehyde (methanal, H₂CO), which are both HAPs. GHG emissions that result from natural gas combustion consist mostly of CO₂ and include lesser amounts of methane (CH₄) and nitrous oxide (N₂O).

Table II. Emissions from the Cleaver-Brooks Boiler

Pollutant	Actual Emissions tons/yr	Potential Emissions		Allowable Emissions lb/hr
		lb/hr	tons/yr	
Particulate Matter (PM _{2.5} , PM ₁₀ , & Total)	0.096	0.094	0.410	0.15
Nitrogen Oxides (NO _x)	1.311	1.280	5.606	n/a
Carbon Monoxide (CO)	1.059	1.034	4.528	n/a
Volatile Organic Compounds (VOCs)	0.069	0.068	0.296	n/a
Sulfur Dioxide (SO ₂)	0.0072	0.0070	0.031	0.0070
Actual Greenhouse Gases (GHGs)	1,504.0	1,468.4	6,431.8	n/a
GHGs as Carbon Dioxide Equivalents (CO _{2e})	1,505.5	1,469.9	6,438.3	n/a

The Cleaver-Brooks boiler is subject to a recordkeeping provision of “Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units” [40 CFR Part 60, Subpart Dc (§60.40c–60.48c)], as adopted at Rule 15.1. The applicable recordkeeping requirement is given in §60.48c(g) and (i) of Subpart Dc.

The boiler is also subject to “National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters,” [40 CFR Part 63, Subpart DDDDD (§63.7480–63.7575)], as adopted at Rule 16.5(c). §63.7515(d) and §63.7540(a)(10) of Subpart DDDDD require an annual performance tune-up of the boiler. The reporting and recordkeeping requirements are given in §63.7550 and §63.7555 of this subpart.

An appropriate BACT [§4-8(e)(2)] limitation for the particulate emissions from the boiler has been previously determined to be 0.15 lb/hr. No controls are necessary in order to achieve this limitation. This limitation is more stringent than the Rule 8.2 (Schedule 2) particulate emission limit of 6.63 lb/hr.

Combustion of natural gas in the boiler at its rated capacity results in potential SO₂ emissions of 0.0075 lb/hr. This SO₂ emission rate is the effective SO₂ emission limitation for the boiler. This limitation is more stringent than the Rule 13.2 SO₂ emission limit of 4 lb/MMBtu, which is equivalent to 50.21 lb/hr for the boiler while it is operating at its rated capacity.

It has been determined that no controls are necessary in order to satisfy BACT (Rule 25.3) for the VOC emissions from the boiler, and no quantitative BACT limitation is necessary for these emissions. No limitations are applicable for the emissions of NO_x, CO, and GHGs from the boiler.

Emission Unit 006 Clarke Emergency Fire-Suppression Pump Engine

The Clarke emergency fire-suppression pump engine burns has an approximate rated capacity of 1.33 MMBtu/hr and a maximum power output of 190 horsepower (141.7 kilowatts). The diesel fuel that is burned in it has a maximum allowable sulfur content of 15 ppm (0.0015%) by weight.

The estimated emissions of particulate, NO_x, CO, VOCs, SO_x, and GHGs (actual and CO_{2e}) that result from diesel fuel combustion in the engine are given below in Table III. VOC emissions were calculated by using emission factors from AP-42 (1996) Table 3.3-1 (power output column). Emissions of particulate (considered to be PM_{2.5}, PM₁₀, and total) and CO were calculated by using emission standards that are found in Table 4 to 40 CFR Part 60, Subpart III. NO_x emissions were calculated by subtracting the VOC emissions (calculated using AP-42) from an emission standard for emissions of NO_x and VOCs combined that is also found in Table 4 to 40 CFR Part 60, Subpart III. SO_x emissions were calculated by using an emission factor from AP-42 (1998) Table 1.3-1. GHG emissions were calculated by using the Tier 1 calculation methodology that is found in §98.33 of 40 CFR Part 98, Subpart C. The potential emissions are based on operation of the engine at its rated capacity for 100 hr/yr while burning diesel fuel that has the maximum allowable sulfur content. GHG emissions that result from diesel fuel combustion consist mostly of CO₂ and include lesser amounts of methane and nitrous oxide.

Table III. Emissions from the Clarke Emergency Fire-Suppression Pump Engine

Pollutant	Potential Emissions		Allowable Emissions lb/hr
	lb/hr	tons/yr*	
Particulate Matter (PM _{2.5} , PM ₁₀ , & Total)	0.062	0.0031	0.062
Nitrogen Oxides (NO _x)	0.772	0.039	1.25†
Carbon Monoxide (CO)	1.093	0.055	1.093
Volatile Organic Compounds (VOCs)	0.478	0.024	1.25†
Sulfur Dioxides (SO ₂)	0.0021	0.00010	0.0021
Actual Greenhouse Gases (GHGs)	155.583	7.779	n/a
GHGs as Carbon Dioxide Equivalentents (CO _{2e})	155.740	7.787	n/a

*Based on operation for 100 hr/yr

†Limitation for combined NO_x and VOC emissions

The new Clarke emergency fire-suppression pump engine is subject to “National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines” [40 CFR Part 63, Subpart ZZZZ (§63.6580–63.6675)], as adopted at Rule 16.5(c). §63.6590(c)(6) of this subpart stipulates that the requirements of the subpart are met for the engine

by meeting the requirements of “Standards of Performance for Stationary Compression Ignition Internal Combustion Engines” [40 CFR Part 60, Subpart IIII (§60.4201–60.4219)]. §60.4205(c) of Subpart IIII stipulates that the engine must meet standards for particulate, CO, and combined NO_x and VOC emissions that are given in Table 4. Recordkeeping requirements are given in §60.4214(b) of Subpart IIII.

§60.4211(f) of 40 CFR Part 60, Subpart IIII, stipulates that the emergency fire-suppression pump engine may be operated without time constraints during emergency situations and for up to 100 hr/yr for testing and other specific purposes. The potential emissions that are given in the preceding table are based upon this operational limitation.

Potential particulate emissions from the new engine are estimated to be 0.27 ton/yr, based on continuous operation. Therefore, the particulate emissions from this engine are subject to Rule 27.3. An appropriate reasonable and proper limitation, in accordance with Rule 27.3, for these emissions is 0.20 g/(kW·hr), which is equivalent to the applicable particulate emission standard that is found in Table 4 to 40 CFR Part 60, Subpart IIII, and stipulated by §60.4205(c) of this subpart. No controls are necessary in order to achieve this limitation. This limitation corresponds to 0.062 lb/hr for the operation of the engine at its rated capacity. It is more stringent than the Rule 10.3 (Schedule 2) particulate emission limit of 0.44 lb/hr, based on a process weight of 68.5 lb/hr (9.71 gal/hr × 7.05 lb/gal). The Rule 10.7 particulate emission limit of 0.25 gr/scf cannot be converted into units of lb/hr because the exhaust flow rate of the engine is not available at this time.

VOC emissions from the new engine are subject to BACT (Rule 25.3). No controls are necessary in order to satisfy BACT for these emissions, and no quantitative BACT VOC emission limitation is necessary. However, the emissions of NO_x and VOCs combined from the engine are limited by an emission standard of 4.0 g/(kW·hr) that is found in Table 4 to 40 CFR Part 60, Subpart IIII, and stipulated by §60.4205(c) of this subpart. CO emissions from the engine are limited by an emission standard of 3.5 g/(kW·hr) that is also found in Table 4 to 40 CFR Part 60, Subpart IIII, and stipulated by §60.4205(c).

§60.4207(b) of 40 CFR Part 60, Subpart IIII, stipulates that the diesel fuel that is burned in the engine must meet the requirements for nonroad diesel fuel that are given in §1090.305 of “Diesel Fuel and ECA Marine Fuel Standards” [40 CFR Part 1090, Subpart D (§1090.300–1090.325)]. §1090.305(b) of Subpart D limits the sulfur content of this diesel fuel to 15 ppm (0.0015%) by weight. Combustion of diesel fuel with this maximum allowable sulfur content in the engine at its rated capacity results in potential SO_x emissions of 0.0021 lb/hr, which is the effective SO_x emission limitation for the engine. The Rule 13.1 SO₂ emission limit of 500 ppm cannot be converted into units of lb/hr because the exhaust flow rate of the engine is not available at this time.

GHG emissions from the new engine are subject to Rule 23. No controls are necessary in order to satisfy reasonable and proper control technology, in accordance with Rule 23, for these emissions, and no quantitative reasonable and proper GHG emission limitation is necessary.

Over an extended time period, the amount of solvent that is withdrawn from Virgin Toluene Storage Tank 4210 is approximately equal to the plant-wide emissions of solvent for that period, except that some solvent is contained in the undistilled residue from the bottom of the solvent recovery still. A review of Toxic Release Inventory (TRI) reports for Sofix from 1993 through 2001 indicates that, on average, approximately 3.5% of the solvent that is withdrawn from Tank 4210 is included in the residue. Taking this into account, **average plant-wide VOC emissions of toluene (from both point and fugitive sources) are calculated to be 12.121 tons/yr** for the period from May 17, 2012, through October 8, 2021, based on toluene withdrawals from Tank 4210 of 32,652 gallons during this period. A toluene density of 7.234 lb/gal at 68°F was used to make this calculation.

Table IV. Plant-Wide Point-Source VOC Emissions of Toluene

Emission Source	Potential Emissions		Allowable Emissions lb/hr
	lb/hr	tons/yr	
Sources Controlled by Carbon Adsorption (001, 002)	1.734	7.594	2.0
Wastewater Air-Stripping System (004)	0.899	3.939	0.90
Total Toluene	2.633	11.533	2.9

Table V. Plant-Wide Particulate Matter Emissions of Color Former Product

Emission Source	Actual Emissions tons/yr	Potential Emissions		Allowable Emissions lb/hr
		lb/hr	tons/yr	
Product Dryer (001)	0.031	0.014	0.060	0.014*
Three Storage Silos (003)	0.013	0.069	0.025	0.069*
Blending Silo (003)	0.019	0.082	0.168	0.082*
Two Filling Machines (003)	0.026	0.034	0.050	0.034*
Total Particulate Matter	0.089	0.199	0.303	0.199*

*0.020 gr/scf

Air Dispersion Modeling

Toluene is a HAP. Inhalation of toluene can result in fatigue, dizziness, confusion, nervousness, headache, nausea, and incoordination. It has a sharp, burnt, pungent odor.

SCREEN2 modeling (assuming flat terrain and no building downwash) of the allowable toluene emissions from all of the applicable emission sources at the plant results in maximum off-site ambient concentrations of 1,830 $\mu\text{g}/\text{m}^3$ (1 hr avg.), 1,281 $\mu\text{g}/\text{m}^3$ (8 hr avg.), and 146.4 $\mu\text{g}/\text{m}^3$ (approximate annual avg.). The concentration resulting from a one-hour averaging time is 0.32% of the REL (15 min avg.) of 150 ppm (574,800 $\mu\text{g}/\text{m}^3$). The concentration resulting from an eight-hour averaging time is 1.7% of the TLV (8 hr avg.) of 20 ppm (76,600 $\mu\text{g}/\text{m}^3$). The concentration resulting from an annual averaging time is 80% of the TLV divided by 420.

The **color former** product that is emitted as particulate matter is included in the class of chemicals that is known as polycyclic organic matter (POM). POM includes organic compounds that have more than one benzene ring and a boiling point of greater than or equal to 100°C. The chemical structure of color former contains four benzene rings. Color former has a melting point of 165°C, and it decomposes before a boiling temperature is reached.

POM, as a class of chemicals, is a HAP. No TLV has been established for POM. A threshold concentration of 10,000 $\mu\text{g}/\text{m}^3$ is given for color former on its safety data sheet. The source of this threshold concentration is not indicated. No health hazards are noted on the safety data sheet.

SCREEN2 modeling (assuming flat terrain and no building downwash) of the allowable color former particulate emissions from the applicable emission sources at the plant, other than from the two filling machines, results in maximum off-site ambient concentrations of 4.218 $\mu\text{g}/\text{m}^3$ (8 hr avg.) and 0.4820 $\mu\text{g}/\text{m}^3$ (approximate annual avg.). The concentration resulting from an eight-hour averaging time is 0.042% of the threshold concentration. The concentration resulting from an annual averaging time is 2.0% of the threshold concentration divided by 420.

Conclusions

The color former production process (Emission Unit 001) is subject to and in compliance with §4-8(e)(2) (BACT particulate and visible emissions) and §4-41, Rule 12 (odor), Rule 16.5(c) (“National Emission Standards for Hazardous Air Pollutants: Miscellaneous Organic Chemical Manufacturing,” Title 40 *Code of Federal Regulations* Part 63, Subpart FFFF), Rule 23 (reasonable and proper gaseous emissions), and Rule 25.3 (BACT VOC emissions) of the Chattanooga Air Pollution Control Ordinance (the Ordinance).

The product recovery and solvent purification process (Emission Unit 002) is subject to and in compliance with §4-41, Rule 12 (odor), Rule 16.5(c) (“National Emission Standards for Hazardous Air Pollutants: Miscellaneous Organic Chemical Manufacturing,” Title 40 *Code of Federal Regulations* Part 63, Subpart FFFF), and Rule 25.3 (BACT VOC emissions) of the Ordinance.

The product handling process (Emission Unit 003) is subject to and in compliance with §4-8(e)(2) (BACT particulate and visible emissions) of the Ordinance.

The wastewater air-stripping system (Emission Unit 004) is subject to and in compliance with §4-41, Rule 12 (odor), and Rule 25.3 (BACT VOC emissions) of the Ordinance.

The Cleaver-Brooks boiler (Emission Unit 005) is subject to and in compliance with §4-8(e)(2) (BACT particulate and visible emissions) and §4-41, Rule 12 (odor), Rule 13 (SO₂ emissions), Rule 15.1 (“Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units,” Title 40 *Code of Federal Regulations* Part 60, Subpart Dc), Rule 16.5(c) (“National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters,” Title 40 *Code of Federal Regulations* Part 63, Subpart DDDDD), and Rule 25.3 (BACT VOC emissions) of the Ordinance.

The Clarke emergency fire-suppression pump engine is subject to and in compliance with §4-41, Rule 12 (odor), Rule 15.1 (“Standards of Performance for Stationary Compression Ignition Internal Combustion Engines” Title 40 *Code of Federal Regulations* Part 60, Subpart IIII), Rule 16.5(c) (“National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines” Title 40 *Code of Federal Regulations* Part 63, Subpart ZZZZ), Rule 23 (reasonable and proper gaseous emissions), Rule 25.3 (BACT VOC emissions), and Rule 27.3 (reasonable and proper particulate and visible emissions) of the Ordinance.

§4-68(d) (“Compliance Assurance Monitoring,” Title 40 *Code of Federal Regulations* Part 64) of the Ordinance is not applicable to any of the emission sources at this facility. The refrigerated condenser unit is inherent process equipment because it is used primarily to recover toluene solvent from the toluene emission sources of the color former production process (Emission Unit 001) and product recovery and solvent purification process (Emission Unit 002). The recovered and purified toluene is reused as solvent in the production process. Furthermore, the two baghouses that serve particulate emission sources of the product handling process (Emission Unit 003) are also considered to be inherent process equipment because they are used primarily to recover sellable color former product. Without the use of these baghouses, approximately 15% of the entire facility production would be lost, making the plant unprofitable to operate.