DRAFT – FOR APPROVAL

ALUF PLASTICS
2 Glenshaw Street
Orangeburg, NY 10962

ENGINEERING INVESTIGATION OF AIR EMISSIONS CONTROLS AT ALUF PLASTICS AND IDENTIFICATION OF REMEDIAL ACTIONS FOR THEIR ENHANCEMENTS

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I. INTRODUCTION

Korlipara Engineering, a professional engineering firm, has been retained by ALUF Plastics (Aluf) to conduct an engineering investigation of the existing emissions control systems at their facility located at 2 Glenshaw Street, Orangeburg, Town of Orangetown, NY 10962 (Figure 1). Specifically, the investigation was conducted by Ravi K. Korlipara, PhD, PE (NYS PE # 070038). A brief description of the qualifications and experience of Ravi K. Korlipara, the engineer performing the tasks outlined in this scope, is attached as Appendix A. He received support in this effort from the staff of Aluf Plastics, who provided access, input, and assistance as needed and appropriate.

The investigation was performed in accordance with the work elements described in the specification document titled "Scope of Investigation – Air Emission Controls at Aluf Plastics," dated October 21, 2016 (SOI), which has been reviewed and approved for implementation by the New York State Department of Environmental Conservation (NYSDEC). This report documents the results of this investigation.

The purpose of this investigation is to perform the following: (1) an assessment of existing facility processes and operations as they pertain to air emissions, particularly potential odor sources; (2) an engineering evaluation of the adequacy and appropriateness of systems installed at the facility for controlling emission rates and concentrations of air contaminants to levels needed to meet permit conditions and odor mitigation; and (3) a review and recommendation of process, operational, and engineering solutions, if needed, in order to achieve compliance with the required air standards.

Although NYSDEC formally approved the SOI in October 2016, Aluf independently commenced investigations regarding the subject matter in approximately April 2016, and the results of the earlier investigations are incorporated into this report. This engineering evaluation and report also included, as appropriate, review and incorporation of pertinent historical records and data related to permitting, flow and emissions rates, and air sampling and air quality analyses performed by third parties.

The details and results of the investigation of air control systems at Aluf areas are presented in this report, together with recommendations and potential engineering solutions/alternatives, if and as needed, to mitigate odors, to enhance emissions control, and to achieve compliance with applicable air standards.

II. BACKGROUND

The investigation performed pursuant to the SOI was conducted at the request of NYSDEC and Aluf. Aluf Plastics currently holds an Air Permit for five emission stacks with carbon media based final filtration to minimize process odors from leaving the facility. The present permit, #3-3924-00190/00006, was issued effective 01/29/2013 with no expiration date.

In approximately March of 2016, NYSDEC and the Town of Orangetown began receiving complaints from residents of Orangetown about odors alleged to emanate from Aluf Plastics. The purpose of this investigation is to do an engineering assessment of the present air emission control systems and to determine their efficacy in preventing odors from traveling beyond the facility fence line and, where appropriate, to recommend additional emission control systems for odor mitigation.

III. EXECUTIVE SUMMARY

Aluf processes plastic materials (primarily low-density polyethylene, with some high-density polyethylene) into plastic bags for commercial, industrial and retail customers in a blown film process. The blown film process refers to manufacture of plastic sheeting in a continuous, cylindrical shape. Aluf also recycles off-specification polyethylene, mainly in the form of scrap from internal Aluf process lines, in its Reprocessing ("Repro") department.

All of Aluf's plastic processing involves extruding, or melting, polyethylene at high temperatures (typically in the range of 400-450 ^{o}F at the low end and 550-560 ^{o}F at the high end). Because of the high temperatures used in the extruders, degradation of the polymer molecules occurs due to the resulting thermal stress, as well as due to mechanical stress in the extruder.

In particular, the polymer undergoes oxidation, resulting in degradation products such as aldehydes (e.g., acetaldehyde, n-butyraldehyde), ketones, and carboxylic acids (e.g., formic acid, acetic acid), as well as emissions of aliphatic hydrocarbons, aromatic hydrocarbons, alcohols, esters, ethers, and other volatile organic compounds, which together appear in the form of oily haze within the production areas inside the building at the facility. A listing of degradation products identified during analysis of site vapor samples and literature sources is attached in Table 1. Emissions from the extruders in the Repro department are higher than in other lines due to slower cooling of the heated plastic and other factors discussed below.

A base polymer material often also contains a package of additives such as slip and anti-block (lubricating agents such as organic amides, stearates, etc., and inorganic silica, talc, mica, etc.), UV stabilizers (e.g., benzophenones), and antioxidants (preservatives such as phenols, phosphites, etc.), to name a few. Heating/extrusion of all of these materials results in oily/waxy fumes and fine dust.

In addition to the above emissions that may be expected from processing of original (virgin) polymer material, some of the recycled material that is processed in the Repro is printed waste plastic (off-specification product from other manufacturers), which introduces additional emissions since it is coated with printing inks. Heating/extrusion of the recycled plastic materials results in smoke with more pronounced oily/waxy fumes compared to virgin material. This phenomenon may also occur in IBC lines using reprocessed material, albeit to a markedly lesser degree, as a very light blue haze at approximately 0-5 or 10% opacity, as distinct from the haze generated in the Repro process with high opacity *if uncontrolled*.

All of the above emissions, if uncontrolled, potentially result in a mixture of odors. However, based on available data from sampling of emissions in the Repro area in 2007, 2011, and 2016, presented in Table 1, concentrations of individual volatile organic chemicals in the Repro emissions are expected to be well below odor thresholds with the exception of the aldehydes acetaldehyde, n-butyraldehyde (butanal), valeraldehyde, and propionaldehyde. Based on worst-case NYSDEC Air Guide-1 screening calculations, all chemicals of concern are expected to attenuate to well below their respective odor thresholds in the air cavity region of the building and before reaching the fence line. Nevertheless, these aldehydes are considered to be the chemicals of concern with respect to any odors emanating from operations at the facility since any upset in air management and filtration could serve to make odors associated with operations detectible beyond the fence line.

Emissions controls for the Repro room and IBC rooms are described in Sections V-VI, below. Based on sampling and literature data, and worst-case modeling calculations, emissions from the IBCs are expected to be well below the odor thresholds within the building cavity. Based on sampling and observations of the Repro room, on the current and historical sampling data of the exiting vapor samples (see Table 1), and on measurement of system performance data, we conclude that the system is adequate and effective in removing the emissions of smoke and oily/waxy fumes from stack emissions, and in reducing the annual and short-term concentrations of the oxidation products to well below the odor thresholds and well below the ambient guideline concentrations within the cavity zone of the building, so long as the system is maintained with a proactive filter and carbon change-out schedule, with regular maintenance of ductwork, blowers, filter boxes, and other components, and with operation of the system at the design flow rates. Concentrations of most of the chemicals in the exhausts were below the applicable odor and ambient guideline thresholds before exiting the building, and the few aldehyde compounds of potential concern had concentrations well below the applicable thresholds even calculated most conservatively within the cavity zone of the building.

In conclusion, the control systems for the IBC and Repro rooms are adequate and effective at capturing the fumes and mitigating stack emissions to below odor thresholds under normal operating conditions.

However, our extended observation of the process area revealed the need and opportunities for mitigation of potential fugitive emissions and improvement of the emissions control systems when operating conditions deviate from normality, as intermittently may occur in a dynamic factory setting. A light blue haze is visible in areas of the plant during operations. The haze would likely be caused by the release of particulates and fugitives during manufacturing as discussed below in detail. This ambient air, potentially containing fugitive fumes, is presently being exhausted to the outdoor air through wall fans whose primary purpose is the removal of process heat. The ejection of the fumes is essentially perpendicular to the wall surface, and when weather conditions allow, the fumes could potentially be carried to downwind receptor locations. It can be assumed that such fumes contain the very aldehydes that are considered to be the chemicals of concern.

<u>Therefore, we recommend the following mitigation measures and best management practices:</u>

- Wall exhaust fans should be removed and subsequently replaced with a ducted room ventilation system with appropriate filtration.

- A haze and dust control system be installed to minimize the potential for such haze and dust to cause fugitive odors; implementation of this system also will improve the indoor environment and facilitate better maintenance of the production area.

- While existing fume hoods in the Repro area are adequate under neutral pressure conditions, we recommend larger/lower hoods where feasible to minimize fugitive emissions potentially resulting from minor pressure fluctuations due to normal facility operations such as the opening and closing of plant doors, drafts created by movement of forklifts and other vehicles, human traffic, and starting and stopping of various machines. Additional fugitive emission mitigation measures are recommended including the installation of (i) spring-loaded closures on enclosure doors used for inspection of Repro extruder showerheads, (ii) articulating spot vacuums for localized fume capture near Repro screen changers and (iii) spring-loaded closures on all exterior doors serving the facility.

- All doors of the building and any other openings should be kept closed as a default condition in all seasons.

- Aluf should continue current and improved best management practices for maintenance and replacement of internal ductwork, filters, filter housings and seals, and carbon media.

All recommended best management practices to minimize or eliminate potential fugitive emissions and odors and to increase filtration prior to stack emissions in order to further mitigate potential odors from stack emissions, including best management practices and mitigation measures implemented by Aluf during preparation of this engineering analysis, are discussed in detail in Section IX below.

IV. EQUIPMENT COVERED BY THE INVESTIGATION

Air control equipment in the five (5) process areas at the facility associated with Air Permit #3-3924-00190/00006 were investigated per the specifications in the SOI. Each of these five (5) process areas exhaust separately to a dedicated stack. Typically, the air control equipment associated with the investigated process areas at Aluf consists of (a) all air handling equipment from air emissions source locations to final exhaust through tall stacks, including emissions capture hoods, blowers/motors, dampers, and ductwork; (b) control units for recovery and mitigation of emissions, including multiple stages of filters, cyclonic separators, impaction separators/pressure equalization chambers, and carbon adsorption units; and (c) monitoring systems, including pressure gauges and manual observation processes.

The five (5) process areas that were investigated are:

1. Reprocessing Room ("Repro") Process Gas/Smoke Capture Vent Hoods Exhaust;
2. Low Density West Room Extrusion Lines Internal Bubble Cooling (I.B.C.) Process Exhaust;
3. Low Density S.E. Room Extrusion Lines Internal Bubble Cooling (I.B.C.) Process Exhaust;
4. Low Density N.E. Room Extrusion Lines Internal Bubble Cooling (I.B.C.) Process Exhaust; and
5. Retail Room Extrusion Lines Internal Bubble Cooling (I.B.C.) Process Exhaust

The details and results of the investigation of air control systems for these five (5) process areas are discussed in the following sections, together with recommendations and potential engineering solutions, if and as needed, to mitigate odors, to enhance emissions control, and to achieve compliance with required air standards.

The following observations were made for each of the five (5) systems covered in this investigation, with the intent to identify any sources of or reasons for odors, and if present, to assess the effectiveness of the existing systems for mitigating same:

- Identification of sources of or reasons for odors
  - Review facility manufacturing processes and operations to identify any opportunities for mitigation at source
  - Review available analytical results and literature related to operations at site to identify potential chemicals of concern
  - Examine the appropriateness and/or adequacy of installed systems (i.e., of the carbon systems discussed separately below) and/or identify other promising technologies and designs to supplement installed systems for mitigating odors that may be caused by the identified potential chemicals of concern

- Evaluation of the condition of systems
  - Evaluate whether all design elements installed are in working order and operating within initial design parameters
  - Evaluate for visible damage
  - Evaluate for signs of abuse or need for better maintenance

- Evaluation of work practices of personnel in the areas covered by each system
  - Functional interactions with systems by operators
  - Interactions by maintenance personnel
  - Preventative Maintenance being performed on an appropriate schedule

- Operational Data
  - Collection of data on air pressures, velocities, volumetric flow rates, to assess adequacy of the systems and to identify potential restrictions
  - Evaluate filter media conditions
  - Evaluate whether emission control systems as designed are adequate for current capacity
  - Evaluate whether any emission, active or passive (including from ceiling vents and/or exhaust fans), is not being captured
  - Evaluate room conditions for evidence of fugitive emissions

- Additional laboratory analysis of filter media
  - Determine effectiveness of carbon bed filtration being used to eliminate odors at the final stage before discharge:
    - Identify a qualified laboratory to evaluate the media being used
    - Testing of used carbon
    - Review of material being processed and compatibility with present carbon bed filtration system
    - Review of alternate filtration systems or filtration system designs that may have better results (if necessary)

V. DESCRIPTION OF INDUSTRIAL PROCESSES AND IDENTIFICATION OF POTENTIAL EMISSIONS OF CONCERN

V.1 THE IBC PROCESS

Low density extrusion lines with Internal Bubble Cooling (I.B.C.) manufacturing processes are operated in four (4) areas of the facility:

- Low Density West Room,
- Low Density Southeast (S.E.) Room,
- Low Density Northeast (N.E.) Room, and
- Retail Room.

Each one of the above process rooms has its own dedicated emissions control system. The Low Density S.E. Room and the Low Density N.E. Room are physically located in one large room (i.e., not physically separated in different rooms), but may be considered as functionally separate because each of the process areas represented by them are exhausted to two (2) independent control systems.

The number of IBC extrusion lines in each of the four (4) process areas is as follows:

- Low Density West Room has six (6) IBC extrusion lines,
- Low Density S.E. Room has five (5) IBC extrusion lines,
- Low Density N.E. Room has seven (7) IBC extrusion lines, and
- Retail Room has 11 IBC extrusion lines.

All IBC extrusion lines belonging to each process area above are directed in parallel to a dedicated common control system (that is, all process lines in each of the four process areas are directed to a single control system, which exhausts via a dedicated stack).

Low-density polyethylene (LDPE) plastic materials are processed in the above Low Density IBC and Retail IBC areas. There is no difference between the IBC process in the Low Density IBC and Retail IBC areas. They are referred to by different names due to the different final destination of the products.

The raw material for Aluf's IBC process is polyethylene beads, also referred to as pellets or resin. Aluf receives its pellets in bulk rail cars from its suppliers. The pellets are vacuumed into holding bins inside the building for storage. Depending on the film to be produced, up to six types of pellets are vacuumed from these bins through aluminum pipes to a “blender,” where they are mixed together by an automated vacuum and weighing system and gravity fed to a top mounted hopper, and from there into the barrel of the extruder. The process is continuous, where raw material is always in supply for the extruder.

Aluf occasionally manufactures scented plastic bags. Fragrance to be included in the bags is added as a micro-ingredient and is received by Aluf already encapsulated in polyethylene pellets. The scent pellets are held in bins and added into the blender when Aluf is ready to manufacture scented products. Scented pellets are added at less than 1% of the total throughput of the extruder; for example, if 100 pounds of pellets are used to manufacture a scented product, less than one pound of those pellets will be scented pellets. Within the pellets, the fragrance ingredient is approximately 5% by weight, meaning that if 100 pounds of pellets are used to manufacture a scented product, approximately 0.8 ounces of the raw material will be fragrance.

Once in the extruder, the material is fully converted within a sealed machine. It enters through an opening near the rear of the barrel and comes into contact with a rotating screw that forces the plastic beads forward into a heated barrel. The desired extrusion temperature is rarely equal to the set temperature of the barrel due to viscous heating and other effects. In most processes a heating profile is set for the barrel, in which five independent controlled heater zones gradually increase the temperature of the barrel from the rear (where the plastic enters) to the front. This allows the plastic beads to melt gradually as they are pushed through the barrel and lowers the risk of overheating, which can degrade the polymer. In the event of overheating, the automated control systems will shut down the line.

At the front of the barrel, the molten plastic leaves the screw and travels through a screen pack to remove any contaminants in the melted material. The screens are reinforced by a breaker plate (a thick metal puck with many holes drilled through it) since the pressure at this point can exceed 5,000 psi.

The blown film process refers to manufacture of plastic sheeting in a continuous, cylindrical shape. This is accomplished by extrusion of pelletized low density plastic through a ring-shaped die. After passing through the breaker plate molten plastic enters the die. The die is what gives the final product its profile and must be designed so that the molten plastic evenly flows to form a cylindrical profile.

The product must be cooled. For films and very thin sheeting as are produced in blown film extrusion, air cooling can be effective as an initial cooling stage. As the molten plastic emerges from the die, it is almost immediately solidified by bringing it into contact with cool air, which is typically done by an air ring that directs chilled air on to the outside of the ring. The opening of the die where the molten plastic exits and meets open air is called the lips. The plastic is continuously forced through the die by the extruder. It is ideal that once the process is stabilized it not be stopped.

In the Internal Bubble Cooling (IBC) process, cool air is also introduced into the internal side of the tube, enabling more rapid cooling, leading to improvements in product quality and increased manufacturing rates. Heat is transferred from the material to the air. Upon sufficient cooling, which occurs almost immediately, the material solidifies, increases and stabilizes in diameter (within inches) and continues to rise as it is pulled upward. The tube formed by the exiting plastic is first manually pulled up a tower, on top of which sits a set of driven nip rollers that pinch the tube closed to capture the air inside the newly formed tube. Once plastic reaches to nip rollers on the top of the tower (the haul off or upper nip) the drive of the nip rollers can be turned on to continue to pull the tube automatically. The tower is typically 30 to 35 feet tall, just below the inside ceiling level of Aluf's plant. The higher the tower the more cooling that is available.

The internal air is rapidly exchanged within the newly formed bubble. The process is dynamically controlled by a computerized control system that continuously monitors and adjusts air flow to maintain the required bubble size. The solidified tube is collapsed into a flattened tube sheet (with two independent layers) at the top of the tower by a pinch roller set for further processing into bags.

V.2 PLASTIC REPROCESSING ("REPRO")

The plastic reprocessing (or "Repro") process involves cutting and shredding polyethylene film, and then extruding the shredded polyethylene for processing into pellets. Recyclable low-density polyethylene (LDPE) film, is processed in the Repro room and converted to pellets for reuse in the Blown Film process lines within the factory. These pellets are the "raw" material for other process lines. The majority of the plastic film recycled is "scrap" from internal Aluf process lines or from other film processors. A minority of the plastic materials recycled in the Repro have printings on them; during the course of this study, the amount of plastic materials sourced from outside parties has been reduced significantly.

Four (4) extrusion lines with a total of seven extruders are used for the Repro process (Figure 2).

Repro Lines # 1, 2, and 4 are used for recycling of plastic film that may have contained printings prior to reprocessing. These lines contain two extruders in series, the first feeding into the second. The extruded polymer exits the first extruder on each line through a "showerhead." The polymer drool is allowed to outgas and cool at this point, as it exits the showerhead, in order to allow off-gassing of any printing inks that may have been present before the polymer is fed into the second re-pelletizer extruder on the line, and sent for further processing (pelletizing). Fumes generated by off-gassing from the extruder showerheads are collected by overhead fume hoods positioned above the showerheads, and are carried through ductwork to additional emissions control systems described in sections VI.2.1 – VI.2.7.

Repro Line # 3 has no showerhead; it is a completely sealed system and the reprocessed material is not exposed to the atmosphere until it is at room temperature. Melt flow is immediately re-pelletized under water. The second extruders on Repro Lines # 1, 2, and 4 are also sealed, and the reprocessed material is re-pelletized under water and is not exposed to the atmosphere until it is at room temperature. The cooling water is continually recycled. Aluf utilizes a filter system for the cooling/transport water, and the fines separated from the cooling/transport water are disposed of as solid waste. No process water is discharged into the sewer system; all process water is recycled.

Because of the high temperatures used in the extruders (typically in the range of 400-450 ^{o}F at the low end and 550-560 ^{o}F at the high end), degradation of the polymer molecules occurs due to the resulting thermal stress, as well as due to mechanical stress in the extruder.

V.3 POTENTIAL EMISSIONS OF CONCERN

V.3.1 *Potential Chemicals in Emissions*

In both the IBC and Repro processes, because of the high temperature of the molten material from the extruder (typically 400-560^{o}F), degradation of the polyethylene polymer molecules will occur due to the resulting thermal stress, as well as due to mechanical shear stress in the extruder and when cool air comes in contact with the film exiting the die lips.

In particular, the polymer undergoes oxidation, resulting in degradation products such as aldehydes, ketones, and carboxylic acids, as well as emissions of aliphatic hydrocarbons, aromatic hydrocarbons, alcohols, esters, ethers, and other volatile organic compounds, which together appear in the form of oily haze. A listing of degradation products identified during analysis of site vapor samples and literature sources is attached in Table 1.

However, in the IBC process, because of rapid cooling by high velocity cooled/chilled air, these emissions would be considerably limited compared to the high rates that would otherwise occur. One of the additional advantages of IBC is that, by continuously exhausting the internal air, volatiles are removed from the interior of the tube, thus minimizing their potential of being trapped inside the tube and getting released later when undergoing further processing (e.g., when converting the flatted tube into bags). Volatiles removed from the interior of the tube are exhausted through the IBC filtering system. Emissions in the Repro process lines equipped with showerheads will be higher than in the IBC lines due to slower cooling at the showerheads, the possible presence of ink out-gassing at the showerheads, and the higher volumes processed in the Repro lines.

V.3.2 *Other Emissions*

A base polymer material often also contains a package of additives such as slip and antiblock (lubricating agents such as organic amides, stearates, etc., and inorganic silica, talc, mica, etc.), UV stabilizers (e.g., benzophenones), and antioxidants (preservatives such as phenols, phosphites, etc.), to name a few. Heating/extrusion of all of these materials results in oily/waxy fumes and fine dust.

In addition to the above emissions that may be expected from processing of original (virgin) polymer material, some of the recycled material that is processed in the Repro is printed waste plastic which introduces additional emissions since it is coated with printing inks. Heating/extrusion of the recycled plastic materials results in smoke with more pronounced oily/waxy fumes compared to virgin material. This phenomenon may also occur in IBC lines using reprocessed material, albeit to a markedly lesser degree, as a very light blue haze at approximately 0-5 or 10% opacity, as distinct from the haze that could be generated in the Repro process with high opacity, *if uncontrolled*.

Again, generation of these fumes is markedly less in the IBC areas compared to the Repro room for comparable material processing rates because of rapid cooling of the material in the IBC process.

All of the above emissions potentially result in a mixture of odors typical of aldehydes.

V.3.3 <u>*Potential Emissions of Concern*</u>

Available data from sampling of emissions in the Repro area in 2007, 2011, and 2016 are provided in Table 1. Emissions data available in the literature (a bibliography is attached as Appendix B) pertaining to emissions of the kind encountered at the facility are also included in this table. The individual chemicals of potential concern are identified in this table together with their measured and/or reported concentrations, and compared to their respective odor thresholds reported in the published literature.

From the data presented in Table 1, concentrations of chemicals in emissions of individual volatile organic chemicals in the Repro outlet may be expected to be well below odor thresholds, except for the aldehydes acetaldehyde, n-butyraldehyde (butanal), valeraldehyde, and propionaldehyde. However, based on worst-case NYSDEC Air Guide-1 screening calculations, all chemicals of concern are expected to attenuate to well below their respective odor thresholds in the air cavity region of the building.[1]

The oily/waxy fumes also have an associated odor. These emissions are significantly lower in the IBC process compared to the Repro process, and are not expected to contribute to odors in plant emissions if they are removed from the exhaust, which would be a function of both the design capabilities and maintenance of the control system. The

[1] The "building cavity" is the low air pressure region in the downwind side of the building. Any contaminants picked up by incoming upstream wind from the intervening building's fugitives and from the intervening stack's emissions (if stack is not tall enough and exhaust momentum is not large enough to escape getting mixed into the wind) can enter the cavity region by downwash of the wind after it passes over the building. Conservatively, by NYSDEC Air Guide-1, the cavity region extends a distance of three times the building height from the downstream side building wall (refined modeling can narrow this distance). If the nearest property line is beyond the cavity region, no offsite receptors are impacted by any contamination in the cavity zone, and if the cavity region extends beyond the property line, offsite receptors can potentially be impacted adversely if contaminant concentrations are above odor thresholds for odor considerations and above Annual Guideline Concentrations (AGC) and Short-term Guideline Concentrations (SGC) for health considerations. The Air Guide-1 formulas used in this analysis yield the most conservative estimates of potential concentration in the cavity zone. Examination of concentrations in the cavity zone is important for verification with respect to AGC, SGC, and odor thresholds since this area would have the nearest receptors. In general, as we move farther away from a source, we would expect concentrations to decrease due to dilution and dispersion, thus generally rendering cavity concentrations to be most conservative.

smoke was removed by the control system from the IBCs area during the inspections, attesting to the system's performance; however, potential break-through emission of oily/waxy fumes will, in general, be dependent on the maintenance of the control system and on making provisions for removing contaminants from the general room environment, as discussed further below. At no time in the months of observations was perceptible smoke visible from any of the five stacks associated with this plant, suggesting that Aluf's current maintenance/filter change schedule is adequate for control of visible emissions.

VI. REPROCESSING ROOM (REPRO) PROCESS GAS/SMOKE EMISSIONS CAPTURE SYSTEM AND EMISSIONS CONTROLS

VI.1 SYSTEM DETAILS

As discussed in detail in Section V.2 above, recyclable plastic materials, primarily low-density polyethylene (LDPE), are processed in the Repro room and converted to pellets for reuse.

VI.2 EXISTING EMISSIONS CONTROL SYSTEMS FOR REPRO

Three of the Repro extrusion lines (lines #1, 2, and 4) have provisions to outgas between stages of the pelletizing process. Smoke fumes generated by the extrusion process on these three lines are collected and passed through an Emissions Control System (ECS). Upon treatment by the ECS, exhaust gases are emitted through a 23″ dia., 66′ tall stack with its top exit located 25′ above the roof of the building. The individual control measures constituting the overall air emissions control system for the Repro lines are discussed in detail below in sections VI.2.1-VI.2.7 below. Figure 1 is a flow schematic for the air treatment system process on the Repro lines.

VI.2.1 Showerhead Fumes Control

The fumes generated in the showerheads after the extruded polymer exits the die of the first extruder on Repro lines #1, 2, and 4 are collected by overhead hoods. To control fumes emitted during this process, the showerheads are enclosed to within 6″-12″ of the feed throat of the second extruder, on all four (4) sides of the showerhead, with three (3) sides being rigid and immovable and the fourth, front side having an openable door that is utilized for maintenance and monitoring of the process as necessary. The oily fumes are captured under negative pressure created by centrifugal blowers located downstream of the hoods via approximately 25-40 feet of connecting ductwork. The blowers and the hoods are sized for 100% capture of the fumes at a minimum face velocity of 100 feet per minute at perimeter surfaces, using entering air as the carrier gas for the fumes, under neutral room conditions (i.e., atmospheric pressure) in the influence area of the showerheads.

After collection by the fume hoods positioned above and around the showerheads, the fumes from Repro Lines #1, #2, and #4 are carried through ductwork to additional emissions control systems described in sections VI.2.2 – VI.2.7.

VI.2.2 Primary Cyclonic Separation of Fumes and Aerosols for Individual Lines

The fumes from the Repro showerheads are directed through approximately 30 feet of ductwork to the primary cyclonic fume/aerosol separation system. As the fumes pass through the ductwork and any intermediate units, they cool and become denser compared to their state when emerging from the showerhead. The oily fumes then pass through one or more high efficiency custom-built cyclones (two (2) cyclones in series for Lines 1 and 2, and one (1) cyclone for Line 4). The high efficiency cyclones were designed to collect particles in the 5-10 micron size range and larger. Any portion of fumes that have coalesced into aerosol form in this size range or larger by the time they have reached the cyclone will be removed by cyclonic action to the design limits of the cyclone (approximately 20% collection efficiency). A portion of any residual fumes that remains as fumes or as smaller coalesced particles will also be removed, since the fumes and smaller particles are denser than the air in which they are being carried, and are therefore flung to the walls of the cyclones, where their deposition is enhanced by the stickiness of the existing collection/coating of fumes. The collected material eventually travels down to a collection drum at the bottom of the cyclone. This somewhat solid waxy material is disposed of according to U.S. EPA and NYSDEC guidelines.

VI.2.3 Secondary Filtration of Fumes and Aerosols for Individual Lines

The gases exiting the final cyclone in each Repro line pass through a Dedicated Line Filter System (DLFS), which is a custom-built three-stage filter assembly consisting of blue polypads (typically 2″ thick), rated at approximately 40% collection efficiency, a 4″ pleated filter rated at approximately 65% collection efficiency, and a 10-pocket 36″-long Vee Bag bag-filter rated at approximately 95% collection efficiency, in that order, for an effective overall collection efficiency of 98.95% for particles sized 5-10 microns and larger. Further condensation of the fumes will occur between the cyclone and the filter assembly, resulting in removal of substantially all of the fumes captured by the Repro fume hoods by the DLFS. The combination of the cyclones and DLFS lessens the load on the filters in the DLFS to increase their useful life.

VI.2.4 Tertiary Filtration of Fumes and Aerosols for Combined Flows from All Lines

After the DLFS on the individual Repro fume hoods, the combined flows from all Repro showerheads flow to a Central Filter System (CFS), which consists of a three-stage filter system that is similar to the above described DLFS, but with double the capacity for additional filtration and protectiveness from individual line fluctuations. The CFS is followed by a 0.3-micron HEPA filter system (99.97% collection efficiency) for final polish and residual smoke removal. Residual fumes exiting each individual Repro line's DLFS condense further by the time they arrive at the CFS, facilitated by long duct runs of approximately 50′ between each DLFS and the CFS, which allows additional cooling and condensation of any residual fumes. The remaining fumes are then filtered by the CFS, a three-stage filter that is similar to the DLFS. Almost all fumes will be removed by this stage, with final polish given by the 0.3-micron HEPA filter. Accordingly, only fumes that escape the Repro fume hoods remain untreated.

VI.2.5 Carbon Adsorption Treatment of Volatile Organic Compounds (VOCs)

After exiting the HEPA filters following the DLFS and CFS, the gases will flow under positive pressure to a custom-built pre-filter housing for a carbon filtration system, which consists of four (4) Flanders PrecisionAire filters (24″x24″x2″) as a redundant filtration measure, and finally to the US Filter, Model RB-10 treatment absorber equipped with 10,000 lbs. of 4x8 carbon mesh size activated carbon (the "carbon bed"). Carbon bed material is a granular carbon produced from coconut shells by a steam activation process. The granular 4×8 Mesh Activated Carbon is manufactured under strictly controlled conditions to produce a porous adsorbent material with high surface area structures.

The purpose of this system is to remove any free organic contaminant molecules potentially present in the fumes and condensates resulting from the extruder emissions that have not been previously removed by the cyclones, DLFS, CFS, and Flanders filters.

VI.2.6 Venturi Scavenging Carbon Adsorption Treatment of Volatile Organic Compounds (VOCs)

The gases exiting the carbon system are augmented with inlets for scavenging air from the Repro room and for supplemental outside air supply in a venturi system installed in the stack. This apparatus is designed to maintain a constant exit velocity in the stack as different process lines go on and off by adjusting compensating air flow, and to enhance drawing in and mixing of air streams, reduce potential backpressure on the carbon system, and increase discharge flow velocity resulting in an increase of the effective stack height. The gases are discharged to the atmosphere through the exhaust stack with its top 25′ above roof level (approximately 66′ above floor elevation). The scavenging inlet has generally been closed, but was available for opening to allow use of Repro room air in the system.

Based on measurements, the flow rates of different lines are typically uniform, with total flow rate of about 9,000 – 10,000 cfm through the CFS and carbon system. The outlet flow rate at the Repro stack was measured to be in the range of about 13,000 cfm – 17,500 cfm, but generally closer to the lower end, resulting in a fresh air contribution of about 30% to 55% of total exiting gas. This fresh air contribution will dilute any fumes that may be present following the filtration systems described above.

VI.2.7 Screens Fumes Control

In addition to the main source of fumes from the showerheads described above, fumes are also generated at the melt flow filter screens of all four extruder lines (including Line #3) when these filtering screens on the extruders are changed mid-process by a device called a "Screen Changer".[2] These sources, generated while the screens are being changed, are also directed into the above described fumes control system as follows:

- The fumes generated when the Screen Changer is activated at the outlets of the extruders are collected by overhead hoods that are typically located approximately 1′-3′ above the source Screen Changers. The screen hood for Line 1 is connected to same duct as the fume hood serving the showerhead on Line 1 prior to the duct's entry into the cyclone. The screen hoods for Lines 2, 3, and 4 are connected in series via a common duct to a filter box with the same construction and specifications as the DLFS described in Section VI.2.3 above. The Screen Changer hoods for Lines 2-4 is then connected to the same CFS described above for the Repro showerhead lines, where the collected fumes commingle with fume flows collected from the showerheads and thence exhaust through the same common stack via the Flanders filters, carbon unit, and venturi/exhaust stack.

VI.3 RESULTS OF ENGINEERING REVIEW OF THE REPRO SYSTEM

We conducted an engineering review of the system performance and ambient conditions in the Repro Room between May to August, 2016, and again in October 2016, including review of operations at different dates and times to gain an understanding and make observations of facility operations over a representative period of time.

The following observations were made with the intent to identify any sources of or reasons for odors, and if present, to assess the effectiveness of the existing systems for mitigating same.

VI.3.1 *Adequacy/Efficacy of the Control System*

The control system for the Repro lines has several increasing levels of protection as emissions progress from source to final exhaust through the stack, including (in progressive direction of flow):

- capture of fumes by the hoods,
- cyclonic separation to remove large condensate aerosol particles reducing filter costs in the process, and
- three levels (3-bank) of filtering of the condensed fumes on the individual lines,
- another 3-bank of filtering on the combined flow from all four (4) lines,
- HEPA filtering on combined flows from all four (4) lines,

[2] The extruders melt the plastic and create a melt stream of flowable plastic. The Screen Changer is a device that allows for the melt stream to be filtered of contaminants, such as bits of metal or wood from packaging, without stopping the extrusion line. In essence the used filter is forced under high pressure (in excess of 10,000 psi) out of the melt stream while the new filter is placed into stream simultaneously. Removing these non-plastics pieces at this point in the process prevents stoppages further downstream when the output of these lines are used elsewhere in the plant.

- pre-filtration for carbon adsorption system,
- carbon adsorption of contaminant chemicals,
- venturi scavenging to maintain constant flow and increased velocity in the stack, and
- final exhaust through the stack.

We have made observations of the conditions in the Repro room and surroundings under normal operating conditions, meaning that the system and the manufacturing lines were operating in a steady condition in a closed environment with no untoward disturbances. A slight background odor was present, typical of plastic processing extruder rooms. All fumes in the extruder showerhead areas were being fully captured by the hood system under normal operating conditions to the extent discernable to the eye; this observation was facilitated by the generally dark-bluish color of the fumes. The emissions exiting the stack were transparent.

Based on the above observations, on the current and historical sampling data of the exiting vapor samples (see Table 1), and on measurement of system performance data, we conclude that the system is adequate and effective in removing the emissions of smoke and oily/waxy fumes from stack emissions, and in reducing the annual and short-term concentrations of the oxidation products to well below the odor thresholds and well below the ambient guideline concentrations within the cavity zone of the building, so long as the system is maintained with a proactive filter and carbon change-out schedule, with regular maintenance of ductwork, blowers, filter boxes, and other components, and with operation of the system at the design flow rates. Concentrations of most of the chemicals in the exhausts were below the applicable odor and ambient guideline thresholds before exiting the building, and the few aldehyde compounds of potential concern had concentrations well below the applicable thresholds even calculated most conservatively within the cavity zone of the building.

In conclusion, the control system for the Repro room is adequate and effective at capturing the fumes and mitigating emissions to below odor thresholds under normal operating conditions.

However, our extended observation of the process area revealed the need and opportunities for improvement of the system when operating conditions deviate from normality, as intermittently occur in a dynamic factory setting; these are discussed next.

VI.3.2 *Opportunities for Mitigation at Source*

(i) Control of Emissions From Screen Changers:

Reinforced extruder filtering screens are installed at the end of each extruder screw barrel, prior to the die assembly, to filter out foreign particles and produce a clean extrusion melt. To run at an optimal process pressure in the Repro room, a screen change is made on each extruder approximately once every four (4) hours on average.

When the screen pack assembly is removed, a resulting puff of fumes/smoke occurs. The hoods that are part of the emission control system captures this initial puff of fumes/smoke. Many times, a block of jammed semi-molten plastic has to be scraped off the screen on to the floor to cool before disposal. The fallen material quenches rapidly in air from a starting temperature that is typically in the range of 400-560 ^{o}F. The heated air rises rapidly due to buoyancy resulting from a decrease in its density caused by heating. Thus, a natural convection current of air flows in the vicinity of the fallen melt material until it is sufficiently cooled. The volume of air flowing during this period of cooling is large because of the very low thermal capacity of air. The molten material thus comes into contact with a large volume of air in a very short time period leading to significant oxidation of the surface material and resulting in the release of large puffs of contaminant emissions, which then spread significantly into the room environment. The existing collection hoods over the screens, which are designed to capture any residual vapor leaks from the screen area, are not designed for capturing these intermittent large-scale emissions from the floor from the occasional block of melt that has to be cleaned out of the screen changer. The existing collection hoods captured only a portion of the fumes in such cases, with the rest expanding into the room environment.

It is important that additional control measures be put in place for these emissions, as they have a markedly deleterious effect on the room environment for an extended period until they are collected by the fume hoods and/or evacuated by the wall fans to the outdoor environment. Making the hoods larger only would not suffice as the puffs are too broad and spread too rapidly. It is recommended that a control system that fully captures the puff plumes be designed and installed.

One recommended design option would be to install a high-flow vacuum hood (e.g., a large heat resistant hose) should be installed to rapidly remove the plume and exhaust it into the existing control system or to an additional unit added to the system. This arrangement would allow the auxiliary hood to be moved over the cooling slug of melted and re-solidified plastic until the dropped material is fully cooled and no visible emissions are seen. An additional recommended design option that was considered is the installation of roll-down curtains surrounding the screen/vacuum area to further capture emissions, but this option was deemed to be infeasible based on the configuration of existing equipment in the screen areas.

An alternative recommended design option would be to quench the material quickly with water (which has a high heat capacity, and thus only a small volume is needed) or through refrigeration or other means. This will rapidly reduce emissions to relatively negligible levels as contact of melt material with oxygen in the air is prevented or drastically reduced. However, any design should provide for controlling and handling the resulting waste streams (e.g., potentially contaminated water/water vapor).

Other methods of controlling the emissions from screen cleaning may also be explored through a feasibility study.

<u>(ii)</u> <u>Control of Emissions Exiting Through Wall Fans</u>:

The back of the Repro section (the eastern wall of the facility) has (3) large 4′-dia. wall fans, each with potential capacity of 3,000 – 4,000 cfm, that are used for removing excess process heat from the building. Presently, these fans are discharging room air potentially containing residual and fugitive contaminants, including the intermittent emissions caused by screen cleaning and replacement, to the outdoor with implications for unwanted odor impact on the outside surroundings. Also, although the fans are located only a few feet below the roof level, they are nevertheless still shielded from weather conditions by the building and any fugitive emissions from the fans could thus settle in the building's cavity region for long periods of time, particularly during atmospheric inversion conditions that would direct air emitted from the fans towards the ground.

It is important that these emissions be mitigated. Although the concentrations are likely to be low, particularly after implementing the corrective measures and upgrades proposed in this document, they may be more immediately felt by passersby as they are close to ground level and can also be carried by wind to outside of the property without mixing and diluting.

It is, therefore, recommended, that the wall exhaust fans be removed, to be replaced with a ducted room ventilation system. The Repro room air can be drawn through filters (MERV 13 or higher as the potential intermittent emissions are fume type particles), through the wall, and elbowed up to the roof. We have considered and ruled out the alternative of installing engineered high-flow high-efficiency filtration boxes that would continuously draw in, clean, and discharge the air back into the Repro room, which would then be withdrawn through ducts and exhausted to roof. This strategy would not serve the purpose of removing process heat from the building.

The exhaust blower may be installed after the filters to help keep it clean. Based on the existing wall exhaust system, it is anticipated that between 10,000 to 16,000 cfm of exhaust may be needed. However, this figure should be confirmed based on achieving ambient room air concentrations below applicable OSHA 8-hour time weighted average thresholds for contaminants for which data is available, and/or other safe levels determined based literature and good engineering judgment.

The exhausted air may be discharged through the existing Repro room stack if engineering considerations allow; otherwise, a new stack may be needed, which would entail obtaining a modification to the existing air permit as it would be a new emission point. This exhausted air may also need to be diverted through a control system if, after making all recommended upgrades and corrections, the fugitive concentrations are still found to have noticeable (e.g., oily, dusty, odorous) impacts. The design should also include provision for makeup air so as to sweep all room contamination towards the exhaust ducts or the existing fume hoods. Care should be taken in the placement, sizing and design of any exhaust/makeup system to ensure that the system will not adversely impact the capture of fumes at the extruder showerheads and screens (e.g., no drawing away of fumes by the room exhaust due to excess negative pressure relative to pressures at the peripheries of the hoods).

(iii) Control of Emissions Not Captured by Hoods:

The melt plastic material exiting the extruder die flows down a showerhead that is enclosed in a rectangular box with a door. As a result of the high temperature of the melt material, oily smoke is generated in the showerhead and at the screens, together with oxidation products. Overhead exhaust hoods are located above the showerheads and the screens for collecting the fumes that are generated continuously during the extrusion process.

Smoke from degradation of the polymer molecules is also released, albeit at a lesser rate by orders-of-magnitude compared to releases at the showerheads and sporadically, (a) at the location where the molten plastic emerges from the extruder and (b) at the location of the extruder screen (Screen) when this screen area is exposed to air (oxygen) during servicing. All Lines 1, 2, 3, and 4 have overhead exhaust hoods for collecting any fumes emanating from the Screen areas.

The hoods and the associated control system were observed to capture all the fumes under normal operating conditions, i.e., when steady room conditions are being maintained in a closed environment. However, when drafts/minor pressure fluctuations were felt, minimal quantities of fumes were observed escaping. This determination was made based on visual observations, which were fairly reliable due to the distinct thickness and color of the fumes.

Further, it was observed that as different production lines turn on and off, building doors are opened and closed, forklifts and other vehicles moves through the area, and other changes occur to the building environment, air pressure conditions sometimes changed leading to leakage of some fumes from the periphery of the hoods occasionally, and for short periods of time. It is, therefore, recommended that, as feasible, the hoods be made larger laterally (preferably by at least 6″), and deepened (preferably by at least 6″), and the hood assembly be lowered to the extent possible, to reduce open area between the source and hood, thus increasing capture volume and velocity. Each extruder line has its own physical limitations due to its particular equipment configuration; so any hood modifications will have to be customized to each extruder line (e.g., if making hood deeper on all sides is not feasible, extending the sides downward where feasible would still help).

(iv) Control of Emissions From Open Showerheads:

The extruded material flows down from the die in the form of a shower stream in the Showerhead. This area is enclosed by a rectangular box that is solid on three sides and a hinged door on the fourth side. It was observed that the door was left open on occasion as the worker left the station to attend to other work pertaining to the line, sometimes for extended periods. Fumes, often in substantial volumes, were found to leave the Showerhead enclosure through the open door, and escaped capture by the hoods that are positioned some distance (typically about the order of a foot) above the top of the

Showerheads, as the hoods are too far distant from the Showerhead door to provide effective capture. These fumes would then migrate through the room environment and potentially exhaust through the wall outlets.

This is an operational issue and can be easily mitigated by adding a spring to close the door automatically upon release by the observing operator. It is important to minimize the period that a Showerhead door is open, as the escaping fumes are not diluted and are emitted directly from cooling polyethylene.

Also, when the door is opened, more air is able to enter the enclosure resulting in greater oxidation of the melt material and thus greater generation of fumes. As a general rule, these doors should be kept shut, and opened only when necessary and then for the shortest possible period. A simple spring should eliminate re-occurrence of significant fugitive emissions from this point.

Employees should be apprised of these considerations and trained to diligently follow the above recommended procedures.

(v) Control of Emissions With Timely Filter Change-Outs:

The emission filters are being changed at least weekly within the useful lifetime of the filters. It has been reported to us by employees that the room environment is of good quality with minimal fugitives when the filters still have useful life, but that, if changing of the saturated filters is delayed for some reason, the room is rapidly impacted with fumes, some of which can then migrate outside the building to cause odor and contamination problems, in addition to degrading the quality of the indoor environment. Such episodes are anomalous and infrequent, and quickly rectified when they do occur due to the impact on air quality within the building, yet it is conceivable that delayed filter changes could lead to odor complaints from offsite receptors. The staff is commended for their diligence regarding this matter, and we recommend that they continue to exercise vigilance to prevent such occurrences. Some methods currently being employed include but are not limited to:

- ensuring that new filters are always in stock at the facility in sufficient quantity to overcome potential vendor shortages and shipment delays based on past usage volume and vendor history;
- having the new filters available conveniently accessible for a quick change-out to minimize disruptions to production, maintain diligent change-out schedule records
- maintaining the gauges in good working order and maintain a record of readings when normal conditions are present and readings that would signal change-out need (e.g., pressure reading increase when filters begin to get clogged); and
- review the schedule and gauge records at the beginning of the shift to ensure that filter capacity is available for the shift and, if not, plan for change-out during the shift and follow through with the change-out as needed.

(vi) Improved Maintenance of Emissions Control Equipment:

The existing filtration equipment and ductwork were installed six years ago and show signs of age. The vulnerable points are mainly seams, turns, joints, entrances, exits, and other change locations. Oily liquid (condensate of the emitted fumes) was seen escaping the filter boxes through the filter box seal gaskets. Ductwork, cyclones, filter boxes, blowers, etc. were also observed to exhibit staining of escaped oily liquid.

All ductwork and appurtenances should be regularly examined for sags and dislocations and should be repaired as they are often the cause of leak prone breaks in the equipment. All gaskets should be regularly replaced and all leaking locations shall be immediately sealed. In general, all equipment should be kept in as clean a condition as possible for an active production environment and for easy identification of leaks. The innards of the ductwork should be regularly inspected for built up deposits of condensed material, and, if needed, should be immediately replaced with new ductwork to maintain and improve capture effectiveness. During the course of this study, all ductwork and appurtenances were inspected and upgraded. Further, the ducts were painted with pigmented coatings to make observations of leakage easier from ground level.

Several differential pressure gauges were either not functional or unusable (coated with contaminants); they should be repaired immediately. Alternatively, the gauge reading taps may be left in place and a portable gauge should be used to record the readings at a prescribed schedule (at least weekly); this is a more cumbersome alternative, but has the virtue of the gauge maintaining a longer useful life without becoming less effective because of long exposure to the fumes when installed permanently as at present. During the course of this study, many of the differential pressure gauges were replaced.

All equipment and ductwork should be inspected and logged at regular intervals at the prescribed schedules (currently weekly, or any time an upset occurs), and preventive maintenance work should be performed to minimize and preferably eliminate accidents and anomalous emissions incidents.

(vii) Control of Dust Emissions in the Repro Room:

Many surfaces in the Repro room are coated with a layer of fine, sticky graying material, perhaps as much as 1-2 millimeters in many places. The material has a waxy feel to touch and leaves a blackish smudge. It should be noted that the problem looks much worse than it may actually be in reality, when we consider that this layering is a result of a few years of deposition. Nevertheless, it indicates the presence of particulates and fugitives in the room environment, with their migration to outdoors (discussed above) having the potential to cause odor complaints.

It is recommended that a dust control system be installed (also recommended above under wall exhausts replacement) to remove this material from the room environment, because of its potential to cause fugitive odors and to improve the indoor environment for better maintenance of the area.

Fine powder such as talc has a waxy feel even in the absence of waxes or oils. Thus, it is possible that the coated material may simply be plastic and additive dust released during the production process. Sampling of this material should be performed to ascertain its composition; depending on the results additional evaluations and mitigation may be performed as necessary and appropriate.

(viii) Reconfiguration of Carbon Bed To Allow Verification Of Emissions Control

The current carbon bed is adequate for emissions control. In an effort to provide additional emissions control, Aluf replaced the carbon bed on December 16, 2016, one year earlier than Aluf's scheduled replacement (vendor schedule suggests replacing carbon every five years; Aluf's replacement schedule is every three years). Aluf replaced the carbon after approximately two years of use. Testing the removed carbon performed by the carbon vendor, included below, show that the removed carbon was still effective for emissions control prior to its removal.

The following is a summary of life testing of the carbon as reported to ALUF.

WESTATES® ACTIVATED CARBON LABORATORY 5375 South Boyle Avenue TELEPHONE 323.277.3083 Los Angeles, CA 90058 FACSIMILE 323.277.3080			
ANALYTICAL REPORT			
LAB No.:	**31935**	ORDER No.:	
CUSTOMER:	**Aluf Plastics** 2 Glenshaw Street Orangeburg, NY	DATE SAMPLED: DATE RECEIVED: DATE ANALYZED:	12/15/2016 12/28/2016 12/28-12/29
CONTACT:	John Giamis	DATE REPORTED:	12/29/2016
TELEPHONE:		EVOQUA REP:	Brian Franks
SAMPLED BY:	Customer	EMAIL:	brian.franks@evoqua.com
SUBMITTED BY:	Brian Franks	TELEPHONE:	(908) 353-7231

SAMPLE I.D.	METHOD ASTM D 3175 VOLATILE MATTER (VM)		METHOD ASTM D 2867 XYLENE MOISTURE (XM)
	Wt %	g VM / 100 g GAC	Wt %
Vapor Carbon	23.9	31.6	0.40

Aluf has retained a third-party laboratory to identify the constituents absorbed by the removed carbon and has been informed by the laboratory that results of that testing will be available no later than January 30, 2017. The purpose of this evaluation is to determine the effectiveness of the carbon in filtering the aldehydes that are associated with odors generated at the facility.

It would be prudent to examine whether the current carbon bed can be reconfigured from a single, 10,000-lb. carbon adsorption system to a dual-stage, 5,000-lb. carbon adsorption system with a test port between the two stages of the carbon bed. This would allow easier testing of the carbon to determine whether breakthrough of the initial stage of carbon filtration has occurred, and could be used to verify that the carbon bed remains effective prior to scheduled carbon change outs.

(ix) Additional Measures for the Repro Room:

It is recommended that all doors of the building and any other openings should be kept closed as a default condition in all seasons to minimize the possibility of fugitive emissions.

VII. LOW DENSITY EXTRUSION LINES INTERNAL BUBBLE COOLING (I.B.C.) PROCESS EXHAUST EMISSIONS CONTROL SYSTEMS

VII.1 EXISTING IBC ROOMS

Low density extrusion lines with Internal Bubble Cooling (I.B.C.) manufacturing processes are operated in four (4) areas of the facility:

- Low Density West Room,
- Low Density Southeast (S.E.) Room,
- Low Density Northeast (N.E.) Room, and
- Retail Room.

Each one of the above process rooms has its own dedicated emissions control system. The Low Density S.E. Room and the Low Density N.E. Room are physically located in one large room (i.e., not physically separated in different rooms), but may be considered as functionally separate because each of the process areas represented by them are exhausted to two (2) independent control systems and two (2) independent stacks.

The number of IBC extrusion lines in each of the four (4) process areas is as follows:

- Low Density West Room has six (6) IBC extrusion lines,
- Low Density S.E. Room has five (5) IBC extrusion lines,
- Low Density N.E. Room has seven (7) IBC extrusion lines, and
- Retail Room has 11 IBC extrusion lines.

All IBC extrusion lines belonging to each process area above are directed in parallel to a dedicated common emission control system. Each process area's emission control system exhausts via a dedicated stack.

VII.2 EXISTING EMISSIONS CONTROL SYSTEM FOR IBCs

All four (4) IBC areas have the same configuration of emissions control system, although some localized details may vary. Figure 2 is a flow schematic for the air treatment system process on the IBC lines.

VII.2.1 Pressure Equalization Chamber/Primary Particle Separator

In all cases, the individual exhaust ducts (from each IBC equipped die) belonging to the particular IBC area are run in parallel to the location of that IBC area's control system treatment units. They are connected there (in parallel) to the Pressure Equalization Chamber/Primary Particle Separator (Equalization Chamber/Particle Separator), which is a 8′-4″ L x 6′ W x 6′ H rectangular steel box with baffled interior.

The Equalization Chamber/Particle Separator has an approximately rectangular opening at the top (typically 18 ″ W x varying length (20″ or more, depending on the IBC room). It also has an approximately 22″ dia. outlet connection on the side for introduction of outdoor air. The purpose of the top and side openings is to render the control system functionally independent of the IBCs, and isolate the IBCs from downstream effects. That is, since the dynamic process of the IBC is finely controlled for quality and production purposes, it is important to dissociate operation of the emissions control system from the IBC process. As the individual IBCs turn on and off, or as they experience changed flow conditions because of production needs, the openings in the Equalization Chamber/Particle Separator provide a means for compensating for the resulting changes in pressure and flow rate in the Equalization Chamber/Particle Separator, thereby avoiding back pressure/flow on the operating IBCs.

Additionally, the staggered baffles create turns for the flow of the combined emissions gases from all lines in order to separate large particles from the remainder of the gases by inertial effect (as gases turn when encountering an obstruction, the heavier particles continue along original path due to inertia, thus impinging on the baffle plate and separating from the rest of the flow). The Equalization Chamber/Particle Separator is opened and the baffle plate cleaned manually as needed.

VII.2.2 Secondary Cyclonic Separation of Fumes and Aerosols for Individual Lines

Due to cooling of the fumes as they pass through the ductwork and any intermediate units, they become denser compared to their state when emerging from the IBCs. The oily fumes then pass through two high efficiency custom-built cyclones (same design as the cyclones utilized for the Repro room) in parallel. The high efficiency cyclones were designed to collect particles in the 5-10 micron size range and larger. Any portion of fumes that have coalesced into aerosol form in this size range or larger by the time they have reached the cyclone would be removed by cyclonic action to the design limits of the cyclone (approximately 20% collection efficiency). A portion of any residual fumes that remained as fumes or as smaller coalesced particles would also be removed. This is because, with the fumes and smaller particles being denser than the air in which they are being carried, they are flung to the walls of the cyclones, where their deposition is enhanced by the stickiness of the existing collection/coating of fumes. The collected material eventually travels down to a collection drum at the bottom of the cyclone. This somewhat solid waxy material is disposed in accordance with applicable U.S. EPA and NYS DEC guidelines.

VII.2.3 Tertiary HEPA/Carbon Adsorption Treatment of Volatile Organic Compounds (VOCs) and Particulates

The exhaust gases from the cyclones will flow under positive pressure to a custom-built 8′-4″ L x 6′ W x 6′ H rectangular steel box housing for banks of HEPA and activated carbon filters with a total of four banks of filters. All flows through this housing must pass through first a HEPA filter to remove particulates (99.97% collection efficiency for particles 0.3 microns and larger) and then activated carbon filtration.

The HEPA filters are changed weekly. Carbon filters are cycled through the housing so that no carbon is in the filter housing longer than 4 weeks and none will be at the face of the incoming flow immediately after the HEPA filter for longer than one week. In other words, the first carbon bank that sees the emission flow is in that position for only a week. During the weekly maintenance, each bank of carbon filters is repositioned one location closer to the incoming emissions flow. The system was designed to remove all volatiles from the IBC units.

VII.2.4 Stack Exhaust

The gases are discharged to the atmosphere through a 23″ dia. exhaust stack with its top 25′ above roof level (approximately 66′ above floor elevation). Based on measurements, the flow rates of different rooms are typically uniform, with total flow rate of about 10,000 – 12,000 cfm through a stack.

At no time in the months of observations was perceptible smoke visible from any of the five stacks associated with this plant, attesting to the adequate maintenance and filter changes by the plant.

VII.2.5 Screen Changers

All extruders in the IBC Rooms have Screen Changers as standard equipment to filter the melt stream as the Repro Department extruders do, see section VI.2.7, above. The Screen Changers on the Repro extruders are very different than those in the IBC Rooms in that the area of exposed plastic is much smaller on the IBC Screen Changers and the action of the Screen Changer mechanism limits molten plastic exposure time to near zero. Visible emissions as a result of screen changes in the IBC Rooms are near zero as opposed to the large puffs that can be observed in the Repro Department. No fumes are generated from these smaller, faster, screen changes in the IBC Rooms and the fume mitigation required in the Repro Department is not needed in the IBC Rooms.

VII.3 RESULTS OF ENGINEERING REVIEW OF THE IBC SYSTEMS

We conducted an engineering review of the system performance and ambient conditions in the IBC Rooms from August to October 2016, including review of operations at different dates and times to gain an understanding and make observations of facility operations with regard to the IBC Rooms over a representative period of time.

The following observations were made with the intent to identify any sources of or reasons for odors, and if present, to assess the effectiveness of the existing systems for mitigating same. All four (4) IBC rooms exhibited similar characteristics and potential areas of concern. Therefore, the following remarks apply to all of them; any specific remarks related to a particular area will be called out.

VII.3.1 Identification of sources of or reasons for odors

The potential emissions of concern, which are a result of the high temperatures used in the extruder, are identified in discussed in Section V.3.1 thru V.3.3 above. The identified degradation products and odor characteristics are listed in Table 1. Also, owing to the presence of additives in the raw plastic, oily/waxy fumes and fine dust are generated. However, due to the rapid cooling of the melt by the IBC, and based on observations, these emissions are generally expected to be significantly less than those generated by the Repro units.

Any emissions resulting from the IBC processes are expected to have a mixture of odors typical of aldehydes. Based on sampling and literature data, and worst-case modeling calculations, emissions from the IBCs are expected to be well below the odor thresholds within the building cavity.

VII.3.2 Adequacy/Efficacy of the Control System

The control system for the IBC lines has several increasing levels of protection as emissions progress from source to final exhaust through the stack, including (in progressive direction of flow):

- capture of fumes by the IBC process,
- pressure equalization to functionally dissociate the operation of the IBCs from that for the control system,
- particle separation by impaction,
- cyclonic separation to remove large condensate aerosol particles reducing filter costs in the process, and
- carbon adsorption of contaminant chemicals, and
- final exhaust through the stack.

We have made observations of the conditions in the IBC rooms and surroundings under normal operating conditions, by which is meant that the system and the manufacturing lines were operating in a steady condition in a closed environment with no untoward disturbances. A slight background odor was present, typical of plastic processing extruder rooms. All fumes in the IBC extruder areas were being fully captured by the IBCs' exhaust system to the extent discernable to the eye; this observation is facilitated by the generally dark-bluish color of the fumes. The emissions exiting the stack were transparent. However, oily material was observed covering the area where the exhaust gases enter the stack. The carbon plates are also reported to get saturated with oily material.

Based on the above observations, and on the current and historical sampling data of the exiting vapor samples, and on measurement of system performance data, we conclude that with the system maintained at a proactive carbon change-out schedule, and with regular maintenance of ductwork, blowers, filter boxes, and other components, and with operation of the system at the design flow rates, it (the system) is adequate in removing the volatile organic emissions in their individual chemical form. However, the system is not adequate and/or is undersized for removal of oily/hazy emissions, and a solution is proposed in the next section.

In addition to this above mentioned exception, our extended observation of the process area revealed additional opportunities for improvement of the system; these are also discussed next.

VII.3.3 Opportunities for Mitigation at Source

(i) Additional Control of Oily Emissions:

When the control system for the IBCs was designed, in anticipation of rapid cooling of the polymer melt exiting the extruder die, particulate filtration was not included as a unit operation. While HEPA filtration has since been added to address residual oily emissions and individual odorous chemicals are being removed to well below odor thresholds, odors associated with any remaining residual oily fumes exhausting from the stack may pose offsite odor problems. Furthermore, removal of the residual oily emissions is recommended for maintaining good control of emissions for reasons of air quality.

Additional filtration steps, such as a second layer of HEPA filtration prior to stack exhaust, may be considered if and as needed.

(ii) Control of Dust Emissions:

Many surfaces in the IBC rooms are coated with a layer of fine, sticky graying material, perhaps as much as 1-3 millimeters in many places. The dust in the IBC rooms is greater than that in the Repro room.

The material has a waxy feel to touch and leaves a blackish smudge. It should be noted that the problem looks much worse than it may actually be in reality, when we consider that this layering is a result of a few years of deposition. Nevertheless, it indicates the presence of particulates and fugitives in the room environment, with their migration to outdoor having the potential to cause odor complaints.

Fine powder such as talc has a waxy feel even in the absence of waxes or oils. Thus, it is possible that the coated material may simply be plastic and additive dust released during the production process. Sampling of this material should be performed to ascertain its composition; depending on the results additional evaluations and mitigation may be performed as needed and appropriate.

Additionally, a light blue haze is visible in the IBC rooms during operations. During our observation, it was most pronounced in the S.E. IBC room, followed by N.E. IBC room and West IBC room. It was not visible in the Retail IBC room during inspection. The haze would likely be caused by the release of particulates and fugitives during manufacturing, as discussed above. The IBC exhaust system removes volatiles from the interior of the extrusion tube and directs the resulting exhaust to the cyclone and additional emissions control systems discussed above. However, there may be residual emissions from the exterior surface contributing to the haze.

Therefore, it is recommended that a haze and dust control system be installed to remove these materials from the room environment, because of their potential to cause fugitive odors and to improve the indoor environment for better maintenance of the area.

It is, therefore recommended that ducted room ventilation systems be installed in the S.E., N.E., and West IBC rooms to capture the haze and dust. (Retail room may be considered for a similar upgrade in the future, if needed.) The air in these IBC rooms can be drawn through filters (MERV 13 or higher as they are fume type particles), and exhausted through the wall or roof. Another alternative to be considered would be to install engineered high-flow high-efficiency filtration boxes that would continuously draw in, clean, and discharge the air back into the IBC rooms, which would then be withdrawn through ducts and exhausted to roof. (Heat will be saved in winter by this latter approach.)

The exhaust blower may be installed after the filters to help keep it clean. Based on the room sizes, at least between 10,000 to 16,000 cfm of exhaust may be needed to achieve between one (1) to two (2) air changes per hour. However, this figure should be confirmed based on achieving room concentrations below applicable OSHA 8-hour time weighted average thresholds for contaminants for which data is available, and/or other safe levels determined based literature and good engineering judgment.

The exhausted air may be discharged through the existing IBC room stacks if engineering considerations allow; otherwise, new stacks may be needed, which would entail obtaining a modification to the existing air permit as they would be new emission points. This air may need to be diverted through a control system if, after making all recommended upgrades and corrections, the fugitive concentrations are still found to have noticeable haze and oily, dusty contamination. The IBC rooms are large and consideration should be given in design for most efficient flow control for maximizing capture and minimizing energy waste. The ducting should be sized and appropriately located to remove large volumes of air at minimally low pressures, and preferably sited away from the IBCs, in order to avoid inadvertently impacting the IBC production process and quality. For this reason, preventing migration of the fugitives into neighboring rooms should be accomplished by appropriate ductwork placement, rather than by negative pressure control.

<u>(iii)</u> <u>Use of Interior Air for Pressure Equalization Chamber</u>:

In the original design, fresh air inlet was included in the Pressure Equalization Chamber to serve as a means for introducing additional outside air as makeup air for the air being exhausted through the stack. However, considering the volume of air available in the IBC rooms and the generally open nature of the rooms, and also considering that the room air should be marked for clearing as discussed in the above paragraph, it is recommended that the fresh air inlet of the Pressure Equalization Chamber be permanently closed, in which case the approximately rectangular openings at the top of the chamber can serve the same function while capturing room air for cleanup (as discussed in the above paragraph).

<u>(iv)</u> <u>Control of Emissions with Timely Filter Change-Outs</u>:

The emission filters are being changed at least weekly within their useful lifetime. It has been reported to us by employees that the room environment is of good quality with minimal fugitives when the filters still have useful life, but that, if changing of the saturated filters is delayed for some reason, the room is rapidly impacted with fumes, some of which can then migrate outside the building to cause odor and contamination problems. Such episodes are anomalous and infrequent, and quickly rectified when they do occur due to the perceptible impact on air quality within the building, yet it is conceivable that delayed filter changes could lead to odor complaints from offsite receptors. The staff is commended for their diligence regarding this matter, and we recommend that they continue to exercise vigilance to prevent such occurrences. Some methods currently being employed include but are not limited to:

- ensuring that new filters and fresh carbon are always in stock at the facility in sufficient quantity to overcome potential vendor shortages and shipment delays based on past usage volume and vendor history;
- having the new filters and fresh carbon conveniently accessible for a quick change-out to minimize disruptions to production;
- maintain diligent change-out schedule records, maintain the gages in good working order and maintain a record of readings when normal conditions are present and readings that would signal change-out need (e.g., pressure reading changes when filters begin to get clogged); and
- review of schedule and gage records at the beginning of the shift to ensure that filter and carbon capacity is available for the shift and if not plan for change-out during the shift and follow through with the change-out as needed.

<u>(v)</u> <u>Control of Emissions With Well Maintained Equipment</u>:

All equipment shall be maintained in good condition, to operate controls systems at optimal efficiency and to enable early detection of anomalies.

All equipment and ductwork should be inspected and inspection results logged at regular intervals at the prescribed schedules, and preventive maintenance work should be performed to minimize and preferably eliminate anomalous emissions incidents.

(vi) Additional Measures for the IBC Rooms:

It is recommended that all wall windows and exhausts should be closed upon installation of the dust control system in the IBC rooms. It is also recommended that all doors of the building and any other openings should be kept closed as a default condition in all seasons.

VIII. HIGH DENSITY EXTRUSION ROOM

The High-Density Room (HD) was not specifically identified in the SOI as a process area requiring investigation. However, the HD Room is briefly discussed due to the potential for fugitive emissions and recommended mitigation.

(i) Description of High Density Room

The High-Density Room (HD) is the smallest room in the factory and has the most automation. Twenty-four (24) small Blown Film Lines create light weight bags virtually automatically and feed a packaging/palletizing system for hands off fabrication from raw material to a final shipping package manufacturing approach. Additionally, the room contains four (4) other extrusion lines which produce master rolls for secondary converting into bags by four (4) off line bag making machines. The room measures 120 feet x 200 feet with a ceiling height of 24 feet. There are no emission stacks associated with this room as none of the extrusion lines are Internal Bubble Cooling capable. The HD extrusion lines operate in essentially the same manner as the IBC lines, except that (1) cool air is not also introduced to the internal side of the plastic tube as it emerges from the die and (2) the raw material for Aluf's HD process is high-density polyethylene (HDPE) resin instead of low-density polyethylene (LDPE) resin.

(ii) Observed Conditions in Room

There was a visible haze in the interior of the room that varied over the timeframe observed (months) from barely perceptible throughout the room volume to 20 to 30% opacity starting at a height 10 feet above the floor up to the ceiling. The source of the haze appeared to be at the extrusion line dies.

(iii) Control of Emissions Exiting Through Wall Fans:

The back of the High Density Room (HD) (the eastern wall of the facility) has (3) large 4′-dia. wall fans, each with potential capacity of 3,000 – 4,000 cfm, that are used for removing excess process heat from the building. Presently, these fans are discharging room air, potentially containing residual and fugitive contaminants present in the haze, to the outdoor with implications for unwanted odor impact on the outside surroundings. Also, although the fans are located only a few feet below the roof level, they are nevertheless still shielded from weather conditions by the building and any fugitive emissions from the fans could thus settle in the building's cavity region for long periods of time, particularly during atmospheric inversion conditions that would direct air emitted from the fans towards the ground.

It is important that these emissions be mitigated. The concentrations of these emissions are likely to be low and the risk they may be more immediately felt by passersby is also low as the fans discharge onto ALUF's rail siding, then an active rail line and finally onto the rear of an industrial building with little chance of a casual contact by a passerby. However, the discharges are close to ground level and can also be carried by wind to outside of the property without mixing and diluting.

It is, therefore, recommended, that the wall exhaust fans be removed, to be replaced with a ducted room ventilation system. The HD room air can be drawn through filters (MERV 13 or higher as the potential intermittent emissions are fume type particles), through the wall, and elbowed up to the roof.

The exhaust blower may be installed after the filters to help keep it clean. Based on the existing wall exhaust system, it is anticipated that between 10,000 to 16,000 cfm of exhaust may be needed. However, this figure should be confirmed based on achieving ambient room air concentrations below applicable OSHA 8-hour time weighted average thresholds for contaminants for which data is available, and/or other safe levels determined based literature and good engineering judgment.

IX. CONCLUSIONS, RECOMMENDATIONS, AND MITIGATION MEASURES IMPLEMENTED TO DATE

Our conclusions and recommendations are described below, along with mitigation measures implemented by Aluf to date.

- Based on pressure and flow measurements in the various lines, the existing system is working effectively per design in terms of absence of blockages in the ductwork and in capture of fumes in all lines and their effective transport through the ductwork to intended destinations. The existing system is also working effectively per design in the removal of fumes and control of emissions by the cyclones, filters, and carbon adsorption system, with the noted exceptions stated above and in this section.

- We have recommended that the ductwork be inspected and repaired at any joints and seams with stains indicative of looseness of connections and/or replaced with new ductwork. Also, it is recommended that all control equipment be cleaned and maintained leak- and stain-free at seams, joints, and edges, because such materials can contribute to trace emissions and fugitive odors.

- Implemented Mitigation Measure: Aluf has inspected all internal exhaust ductwork connected to the five (5) process areas investigated above. Any leaks discovered in this inspection have been repaired. To further enhance the visibility of any future leaks, all ducts have been painted with epoxy sealing paint. Any leaks that develop in the future will be visible as a stain on the sealing paint and will be immediately repaired. Inspection and immediate replacement of leaking ductwork is recommended to be standard practice.

- Implemented Mitigation Measure: Aluf has replaced outdoor ductwork leading to and from the carbon bed. The new ductwork will be painted with epoxy sealing paint as soon as weather permits. Any leaks that develop in the future will be visible as a stain on the sealing paint and will be immediately repaired.

- The seals of the filter boxes are showing signs of being ineffective. Reinstalling seals or installing new seals, and cleaning of the boxes can improve performance. Aluf should devise a maintenance and replacement schedule for the filter box seals to ensure that they remain effective.

  - Implemented Mitigation Measure: As of the date of this report, Aluf has inspected and internally cleaned all filter/housings and seals. Aluf has attempted to source a supplier to replace the filter housings, but the housings were custom-made for Aluf and the original supplier is no longer in business. Aluf will continue its efforts to locate a replacement supplier for the housings.

- In a large facility with complex operations, minor fluctuations in pressure conditions in a room are normal and unavoidable due to normal facility operations such as opening and closing of plant doors, drafts created by movement of forklifts and other vehicles and of human traffic, and starting and stopping of various machines. Therefore, although existing hoods are adequate under neutral pressure conditions, slightly larger hoods, about 6″ longer (or as much longer as feasible given site restrictions) on each side are recommended to further minimize fugitives. Lowering of the hoods to increase effectiveness is not feasible in all locations because of the current configuration of piping; however, extending downwards by about 6″ on sides where free space is available may be considered as an additional preventive measure. Aluf should also install spring-loaded closures on the doors on showerhead enclosures to reduce or eliminate fugitive emissions during maintenance/inspection by ensuring that these doors do not remain open longer than necessary. It is also recommended that all doors of the building and any other openings should be kept closed as a default condition in all seasons.

  - Implemented Mitigation Measure: Aluf has instructed staff not to open plant doors during operation, and taken measures to ensure that staff follow instructions by alarming plant doors and placing additional surveillance cameras at plant doors to identify whether, when and by whom plant doors are opened during operation. This measure should reduce pressure fluctuations and reduce potential fugitive emissions.

- The existing system is adequately sized, positioned, and designed for effective capture of fumes from the showerhead sources and for their treatment (collection and carbon adsorption), with the exception of minor fugitive losses mentioned above. However, the collection systems associated with the screens need enhancements. The hoods are positioned too high and are undersized for complete capture of fumes from the screens, and not the correct solution for capture of fumes from semi-molten plastic that is intermittently scraped off the screens on to the floor. Although these incidents occur sporadically, the uncaptured emissions could be substantial at times, particularly from semi-molten plastic placed on the floor. In our estimation, controlling these emissions would be essential to further greatly improving the current fair quality of air in the Repro Section and eliminating potential fugitive emissions. This can be accomplished through a combination of design modifications, including increasing the size of the hoods and/or custom-configuring the shape of the hoods to the physical needs and restrictions of the individual screen areas, positioning the hoods to more optimal locations, making available articulating spot vacuums for localized fume capture near screens and on-floor deposits of semi-molten plastic. Other process changes that may be considered include rapid quenching of the materials on the floor with water, or oxygen depletion by throwing fire-proof blankets on the materials on the floor until they cool.

- Since fume emissions from screens occur only sporadically when screen servicing is performed, and since not all screens are likely to be serviced at the same time, it is anticipated that any increases in capture flow rates due to enhancements to existing control systems at the screens recommended in the above paragraph will still be accommodated within the 9,000 cfm design parameters of the Repro central system (CFS and carbon adsorption). However, if it is determined during detailed design of the screen capture enhancements that increased system capacity is needed, additional measures will be needed or alternative approaches may be considered.

- The ambient air, potentially containing fugitive fumes, is presently being exhausted to the outdoors through wall fans for removal of process heat. The ejection of the fumes is essentially perpendicular to the wall surface, and when weather conditions allow, the fumes could potentially be carried to downwind receptor locations. It is therefore recommended that the wall exhaust fans be removed, to be replaced with a ducted room ventilation system. The Repro room air can be drawn through filters (MERV 13 or higher as the potential intermittent emissions are fume type particles), through the wall, and elbowed up to the roof.

  The exhaust blower may be installed after the filters to help keep exhaust clean. Based on the existing wall exhaust system, it is anticipated that between 10,000 to 16,000 cfm of exhaust may be needed. However, this figure should be confirmed based on achieving ambient room air concentrations below applicable OSHA 8-hour time weighted average thresholds for contaminants for which data is available, and/or other safe levels determined based literature and good engineering judgment.

The exhausted air may be discharged through the existing Repro room stack if engineering considerations allow; otherwise, a new stack may be needed, which would entail obtaining a modification to the existing air permit as it would be a new emission point. This exhausted air may also need to be diverted through a control system if, after making all recommended upgrades and corrections, the fugitive concentrations are still found to have noticeable (e.g., oily, dusty, odorous) contamination. The design should also include provision for makeup air so as to sweep all room contamination towards the exhaust ducts or the existing fume hoods. Care should be taken in the placement, sizing and design of any exhaust/makeup system to ensure that the system will not adversely impact the capture of fumes at the extruder showerheads and screens (e.g., no drawing away of fumes by the room exhaust due to excess negative pressure relative to pressures at the peripheries of the hoods).

  - Implemented Mitigation Measure: Aluf has solicited vendors for exhaust/filtration systems and had vendors visit the facility to take required measurements to develop plans to exhaust internal building air through bag/HEPA filters. Aluf has obtained a price quotation from one vendor and is awaiting receipt of a second price quotation from another vendor. Aluf intends to implement this solution pending approval of NYSDEC and modification of the existing air permit (if necessary).

- The venturi system in the stack that accelerates the exhaust from the carbon system is presently capable of augmenting stack exhaust with either internal (Repro room) air or with outside air to achieve the desired exhaust velocity. Given the potential for fugitive emissions in the Repro room, it is recommended that the scavenging inlet in the Repro room be permanently closed.

  - Implemented Mitigation Measure: Aluf has permanently closed the venturi scavenging inlet in the Repro room.

- Pressure taps before and after filters (and also other areas of ductwork where monitoring is desired) are recommended in lieu of the present permanent arrangement of the pressure gauges due to the sticky nature of fumes flowing through the ductwork and their potential to block pressure tap passages. A portable pressure gauge may be used at these taps when readings are needed. Filters were being changed weekly within the lifetime of the filters; thus, this issue was not a limitation, but pressure differentials may be used for better filter monitoring and optimization if and as needed.

Additional modifications that may be considered are as follows:

- Cyclones appear to be effective, but consider potential for improvements and/or placing additional units in series, since any additional material removed from them will result in improved filter lifetime and emissions control.

- Survey for filters with similar or better collection efficiencies to determine whether filters can be changed more frequently without negatively affecting emissions control. Consider more frequent changes of existing filters if improved emissions controls result.

    - Implemented Mitigation Measure: Aluf has experimented with adding filtration to the I.B.C. lines. As discussed in detail above, I.B.C. exhaust passes through cyclones for separation of solids and waxes, then a multi-stage bank of filters, then carbon filtration. There are four banks of carbon filters. Aluf added 25% more carbon to the first bank and observed for process upsets and odor control. On subsequent weeks 25% more carbon was added to each bank sequentially, and monitoring for process stability and odor control was performed prior to the addition of carbon to the next bank.

    - Implemented Mitigation Measure: For the Repro room, paper and HEPA filter changes were increased from once weekly to twice weekly; after examination of filter condition indicated that once-weekly filter changes were sufficient and filters did not fail or clog with once-weekly filter changes, and noting no improvement in amount or frequency of complaints during twice-weekly filter change experiment, filter changes were returned to once weekly.

    - Implemented Mitigation Measure: For the I.B.C. filter systems, Aluf implemented weekly inspection and replacement of HEPA filters and weekly inspection of the sequential carbon filters. On a weekly rotating basis, the first line of carbon filters is removed and replaced, the second line is moved up to the first position, and so on through the third and fourth position; no carbon filter layer is used beyond four weeks, but if weekly inspections reveal any deficiency in any carbon filter layer it will be immediately replaced.

    - Implemented Mitigation Measure: In an effort to provide additional emissions control, Aluf replaced the carbon bed on December 16, 2016, three years ahead of the manufacturer's recommended life expectancy and one year earlier than Aluf's scheduled replacement (vendor schedule suggests replacing carbon every five years, Aluf's replacement schedule is every three years). Aluf replaced the carbon after approximately two years of use.

- Due to community complaints regarding fragrance odors, Aluf should consider reducing or eliminating manufacture of scented products or implementation of additional controls to eliminate potential emissions of fragrance.

    - Implemented Mitigation Measure: Aluf halted manufacture of scented products at its Orangeburg facility on November 9, 2016. However, Aluf has continued to receive community complaints regarding fragrance odors after that time. This suggests that the source of the complaints of fragrance odors is not linked to Aluf's manufacture of scented products, and that resumption of manufacture of scented products may resume without causing odor issues. Should Aluf resume manufacture of scented products at its Orangeburg facility, it may also consider limiting manufacture of scented products to specific days of the week in order to further verify that Aluf's manufacturing is not the source of community complaints regarding fragrance.

Additional mitigation measures approved by DEC shall be implemented by Aluf within 60 days of Department approval of this final Report.