ATTACHMENT A TO THE STAFF REPORT

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Technology Assessment for:

PROPOSED RULE 1133: EMISSION REDUCTIONS FROM COMPOSTING AND RELATED OPERATIONS

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LIST OF ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
AQMD	South Coast Air Quality Management District
AQMP	Air Quality Management Plan
BACT	Best Available Control Technology
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CIWMB	California Integrated Waste Management Board
EPA	U.S. Environmental Protection Agency
LEA	Local Enforcement Agency
NH_3	Ammonia
NPDES	National Pollutant Discharge Elimination System
PM10	Particulate Matter with Aerodynamic Diameter less than 10 Microns
RWQCB	Regional Water Quality Control Board
RCRA	Resource Conservation and Recovery Act
ROG	Reactive Organic Gas
SIC	Standard Industrial Classification
SIP	State Implementation Plan
VOC	Volatile Organic Compound

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EXECUTIVE SUMMARY

Background

The South Coast Air Quality Management District (AQMD) is the local agency responsible for air quality assessment and improvement in the four-county area that includes Orange, the non-desert portions of Los Angeles and San Bernardino Counties, and most of Riverside County. In order to accomplish its mandate, AQMD is required to adopt and implement an Air Quality Management Plan (AQMP) that identifies the control strategies to achieve federal ambient air quality standards and demonstrate compliance with the state and federal clean air acts. The South Coast Air Basin (Basin) is a serious non-attainment area for PM10 (particulate matter less than 10 microns) and must attain the standard by 2006. The Basin is the only extreme ozone non-attainment area and must attain the standard by 2010. Ammonia is a precursor of PM10, particularly aerosol ammonium nitrate and ammonium sulfate. Volatile Organic Compounds (VOCs) are precursors to ozone. As shown in this report, composting of greenwaste only produces significant VOC emissions and appreciable ammonia emissions. Composting of sewage sludge and manure produces significant ammonia emissions in localized areas, as well as VOC emissions.

The 1997 AQMP and the 1999 Amendments to the 1997 Ozone State Implementation Plan (SIP) for the South Coast Air Basin included Control Measure WST-02 – Emission Reductions from Composting. This technology assessment report provides information developed as part of the rule development efforts undertaken to date by AQMD staff to implement Control Measure WST-02.

This report provides background information and rule development recommendations that will be submitted to the AQMD Governing Board at the April 5, 2001 Pre-Hearing for Proposed Rule 1133 – Emissions Reductions from Composting and Related Operations.

Industry Profile

The composting and related operations industry within the AQMD's jurisdiction includes 277 facilities categorized as follows: co-composting facilities; greenwaste only composting facilities; chipping and grinding facilities; and, exempt facilities. Co-composting facilities use putrescible materials, such as, wastewater sludge, manure, or food waste in combination with greenwaste as their process feedstock. Greenwaste composting facilities are composting facilities that only use greenwaste as process feedstock. Chipping and grinding facilities are facilities dedicated to the size reduction of greenwaste for uses such as alternative daily cover, biomass fuel, mulch, soil amendments, or composting feedstock. Finally; exempt facilities are facilities that are part of this industry but are likely to be exempt from regulation under Proposed Rule 1133.

Emissions Inventory

The baseline emissions inventory estimated for the industry is 4.7 and 6.8 tons per day for ammonia and VOC, respectively. The co-composting emissions inventory is estimated at 3.7 and 2.2 tons per day of ammonia and VOC, respectively. The greenwaste composting emissions inventory is estimated at 1.0 and 4.4 tons per day of ammonia and VOC, respectively.

The largest co-composting facilities are estimated each to emit 100 to 300 tons per year of VOC and 150 to 500 tons per year of ammonia. The largest greenwaste composting facilities are estimated each to emit 250 to 600 tons per year of VOC emissions, which would rank them among the largest VOC sources in the Basin.

The baseline emission inventory is based on source tests and emissions studies conducted by AQMD staff. The CIWMB subsequently conducted a series of source tests at greenwaste processing and composting facilities in December of 2001. Although the final results have not been completely reviewed by AQMD staff in time to be included in this report, AQMD staff will incorporate those test results to the greewaste composting emissions analysis and report the revised analysis to stakeholders as soon as possible.

Technical Assessment

AQMD staff has conducted a technology assessment of the composting and related operations industry. The technology assessment reviews composting processes available to industry including the following: windrow, aerated static piles, and in-vessel. The analysis also evaluated ASP systems and enclosures in combination with bio-filtration systems. Based on this analysis, AQMD staff demonstrated that there are technological options that will significantly reduce emissions from the composting and related operations industry.

Control Options and Socioeconomic Analysis

AQMD staff developed three control scenarios to evaluate the potential emission reductions and cost of controlling co-composting and greenwaste composting.

Scenario one assumes the enclosure of the active and curing parts of the composting process, the use of an ASP or in-vessel system, and venting of emissions to control equipment (i.e., biofilter). *Scenario two* assumes enclosure of the active phase of the process and the use of an ASP or in-vessel system with emissions vented to control equipment. For the curing phase of the process, scenario two has a variation for co-composting and greenwaste composting. For co-composting, scenario two assumes the use of a negative-pressure ASP system with emissions vented to controls (no enclosure). For the greenwaste composting, scenario two assumes no controls for the curing phase of the process. Finally, *scenario three* assumes the use of a negative-pressure ASP system for both the active and curing phases of the process with emissions vented to control equipment (no enclosures).

As part of the cost analysis, AQMD staff has analyzed cost-effectiveness and compliance affordability. In general, while the control options for the co-composting sector of the industry are seen as feasible and effective, they are costly.

Relative to co-composting, the control options for the greenwaste composting sector of the industry are more cost effective. However, the affordability analysis, as presented in Chapter IV, demonstrates that the cost impact for this industry would be substantial.

Recommendation

Based on information in this report, AQMD staff is recommending that AQMP Control Measure WST-2 – Emission Reductions from Composting, be implemented in two phases. The first phase would consist of an adoption of a fact-finding rule that would have the elements listed below. The first phase would also include control requirements for new co-composting facilities with total throughput design capacity of 100,000 tons per year. The second phase would consider composting control technologies for new and existing facilities based on the results of additional technical work described below.

Requirements for Co-Composting

As described in this report, co-composting facilities are major sources of VOC and ammonia emissions (e.g., a 100,000 ton/year total throughput facility has annual emissions of 89 tons/year VOC and 147 tons/year ammonia). Based on local community concerns and industry studies, siting of large co-composing facilities in urban areas now requires active consideration of enclosed and controlled facilities to address public health and nuisance concerns. Enclosed ASP or in-vessel systems with control equipment, while feasible and effective at significantly reducing emissions, are costly. Therefore, AQMD staff recommendations are as follows:

Existing and new Co-Composting Facilities

- One-time registration with AQMD;
- Annual reporting requirements;
- PM10 controls to prevent visible PM10 emissions over the property line during operations and from compost piles; and,
- Compliance with all applicable AQMD rules, regulations and permit conditions.

New Co-Composting Facilities with a Design Capacity > 100,000 tpy

- Scenario II control requirements for new facilities with total throughput designed capacity of 100,000 tons per year;
  - ✓ Enclosure and ASP for the active phase of the process with emissions vented to a bio-filtration system;
  - ✓ Open ASP for the curing phase of the process with emission vented to a bio-filtration system;

Greenwaste Composting

As described in this report, the greenwaste industry represents a significant source of VOC emissions. Control options, in general, are more cost-effective; however, our affordability analysis indicates that these controls may have adverse impacts on the industry. As a result, the staff is proposing minimal requirements on greenwaste composting at this time. The requirements are intended to primarily track operations and emissions, so that emission reductions can be claimed if specific controls are implemented in the future. The following summarizes the proposed requirements for existing and new greenwaste composting operations.

- One-time registration
- Annual reporting requirements
- PM10 controls to prevent visible PM10 emissions over the property line during operations and from compost piles; and,
- Compliance with all applicable AQMD rules, regulations and permit conditions.

In light of the fact that there are feasible control options for this industry that are not yet affordable, AQMD staff is recommending that, through the District's Legislative Committee, special funding from the state legislature be sought to implement state-of-the-art composting methods, including but not limited to, enclosed ASP. AQMD staff will work with the CIWMB and CARB to seek additional funding and/or make existing funding directed more towards air quality spending.

The administrative requirements for the proposed rule are detailed in Chapter V of this report. These requirements would include a one-time registration with AQMD and annual reporting.

<u>Chipping and Grinding Operations</u>
Chipping and grinding operations can be sources of PM10 and VOCs. PM10 results from the chipping, grinding and screening of green materials. It can also result when high winds entrain material from processed material piles. Chipped and ground material that is not removed or further processed can decompose anaerobically, resulting in odors and higher levels of VOCs. To address these issues, AQMD staff is proposing the following requirements:

- One-time registration;
- PM10 controls to prevent visible PM10 emissions over the property line during operations and from processed material piles;
- Holding time restrictions on curbside fines and processed green material piles; and
- Compliance with all applicable AQMD rules, regulations and permit conditions

As part of this proposal, AQMD staff is also recommending that the Governing Board direct staff to continue the rule development efforts with the following objectives: 1) continue to evaluate ongoing emissions studies and refine the emissions inventory for the industry; 2) refine the socioeconomic analysis; 3) work with the Integrated Waste Management Board, sanitation districts and other pertinent agencies to identify sources of funding to help reduce the cost of compliance for the greenwaste composting sector of the composing industry. Finally, AQMD staff is further recommending that a Technical Advisory Committee be formed and serve as a forum to address technical issues related to Proposed Rule 1133. There will be annual status reports to the AQMD Stationary Source Committee on facility emissions and the feasibility of implementing additional cost-effective controls.

CHAPTER I

BACKGROUND INFORMATION

INTRODUCTION

This chapter discusses the following:

- ✓ Air quality;
- ✓ Composting Process;
- ✓ Chipping and Grinding Activities;
- ✓ Overview of Current Regulatory Requirements;
- ✓ Other Issues Facing the Composting Industry; and,
- ✓ Necessity for Proposed Rule 1133.

AIR QUALITY

The AQMD is the local government agency responsible for air quality assessment and improvement in Orange county, the non-desert portions of Los Angeles and San Bernardino counties, and most of Riverside county. AQMD jurisdictional boundaries include all of the South Coast Air Basin (SCAB) and portions of the Salton Sea Air Basin (SSAB). AQMD air monitoring indicates that these air basins exceed State and federal health-based air quality standards for PM10 (small particulate matter less than 10 microns in diameter) and ozone. Accordingly, the U.S. EPA has designated both the SCAB and the SSAB as serious non-attainment areas for PM10. The designation for ozone is extreme and severe-17[1] for SCAB and SSAB, receptively. Under the federal Clean Air Act, the AQMD is required to attain the PM10 standards for both of these air basins by 2006. For ozone, the AQMD is required to attain the ozone standards by 2010 and 2007 for SCAB and SSAB, respectively.

In order to attain healthful air, federal and state laws require the AQMD to adopt an Air Quality Management Plan (AQMP) that identifies a control strategy to demonstrate compliance with federal ambient air quality standards and expeditious progress toward state air quality standards.[2] To address these state and federal mandates, the 1997 AQMP and 1999 Amendments to the 1997 Ozone State Implementation Plan for the SCAB included Control Measure WST-02 – Emission Reductions from Composting. These air plans identified composting as a source of ammonia, PM10, and VOC emissions. As such, Control Measure WST-02 calls for the development of viable controls to reduce the emissions from this industry by 2001. Proposed Rule 1133 – Emission Reductions from Composting Operations and Related Operations, has been developed to implement Control Measure WST-02.

Following is a brief description of the health and environmental concerns with air contaminants emitted from composting and related operations that contribute to the formation of PM10 and ozone. Bioaerosols, which are organisms (including aspergillus fumigatus, endoctoxin, and organic dust) dispersed through the air that can affect human health, are not addressed in this report. Finally, since U.S. EPA regulates pathogens, which are bacteria, viruses, and parasites found in most compost

[1] Name given to a severe ozone non-attainments are with a 1988 ozone design value between 0.19 and 0.28. The attainment date is 17 years (instead of 15 years) after the date of enactment of the Clean Air Act Amendments of 1990.

[2] California Health and Safety Code Section 40460(a).

feedstocks, and the regulations are considered effective in pathogen destruction by experts in the field, this issue is also not addressed in this technology assessment.

Particulate Matter (PM10)

Composting and related operations (i.e., chipping and grinding) are sources of direct PM10 and ammonia, which is a PM10 precursor. Ammonia in the atmosphere reacts with nitric acid and sulfuric acid to produce nitrate and sulfate particles, a constituent of PM10.

PM10 is generated when composting piles are turned, moved, and from wind entrainment of static uncovered piles. Associated activities like chipping and grinding also produces PM10 emissions when the wood and greenwaste are mechanically ground and shredded. Biological degradation (or decomposition) of organic materials (i.e., yard waste, manure, sewer sludge, etc.) that occurs during composting and when chipped and ground material begins to rot produces ammonia. Ammonia is produced in both aerobic (in the presence of oxygen) and anaerobic (in the absence of oxygen) environments. Composting is an aerobic process but can become anaerobic when for example, a pile is built incorrectly, the pile gets too little oxygen, the temperature is too high, or there is too little or too much moisture. Chipped and ground material that is left unmanaged likewise begins to decompose and produce ammonia emissions for the same reasons as composting.

PM10 is a public health concern since particles less than 10 microns can be deposited in, and can damage, the airways of the lower respiratory tract and the gas-exchange portions of the lung. The adverse health effects of particulates, especially PM10, are well documented. Various health studies have linked PM10 emissions to increased respiratory infections, more severe asthma, declines in pulmonary function, and shortened life spans. Specifically, recent studies indicate that the current ambient levels of PM10 (30 to 150 $\mu g/m^3$) experienced in many different communities in the United States are associated with increases in daily cardio-respiratory mortality and in total mortality, excluding accidental and suicide deaths. Increases in ambient PM10 levels have also been shown to result in increases in acute respiratory hospital admissions, school absences in children, and increases in the use of medications in children and adults with asthma.

Ozone

VOCs are produced during the anaerobic (in the absence of oxygen) decomposition of organic material. Decomposition occurs when chipped and ground material is composted or when the material is left in an unmanaged state and begins to rot.

There are no state or national ambient air quality standards for VOCs because they are not classified as criteria pollutants. VOCs are regulated, however, because VOCs contribute to the formation of ozone and are transformed into organic aerosols in the atmosphere, contributing to higher PM10 and lower visibility levels. Ozone is formed in the atmosphere through a photochemical reaction of VOC and NOx.

Ozone is a deep lung irritant, causing the lung passages to become inflamed and swollen. Exposure to ozone produces alterations in respiration, the most characteristic of which is shallow, rapid breathing and a decrease in pulmonary performance. Ozone reduces the respiratory system's ability to fight infection and to remove foreign particles. People who suffer from respiratory diseases such as asthma, emphysema, and chronic bronchitis are more sensitive to ozone's effects. Early studies suggested that long-term exposure to ozone results in adverse effects on morphology and function of the lung and acceleration of lung-tumor formation and aging. Ozone exposure also increases the sensitivity of the lung to bronchoconstrictive agents such as histamine, acetylcholine, and allergens.

COMPOSTING PROCESS

Composting is a biological process where organic materials (i.e., leaves and grass, yard trimmings, agricultural crop residues, etc.) are decomposed by microorganisms to create a soil-like material called compost. While decomposition occurs naturally anywhere plants grow, the process has also been industrialized whereby green and wood wastes are mechanically ground and shredded accelerate and control the decomposition process.

Sometimes the green and wood waste is mixed with putrescible wastes (i.e., manure, horse shavings, food waste, sewer sludge, etc.). In this region, with the exception of three facilities, the material is moved with front-end loaders into long piles called windrows. The windrows are then mechanically turned generally with front-end loaders to increase aeration and provide oxygen to facilitate the decomposition process. The temperature and moisture are monitored to optimize and hasten decomposition. After two to four months in the windrows, the material becomes compost.

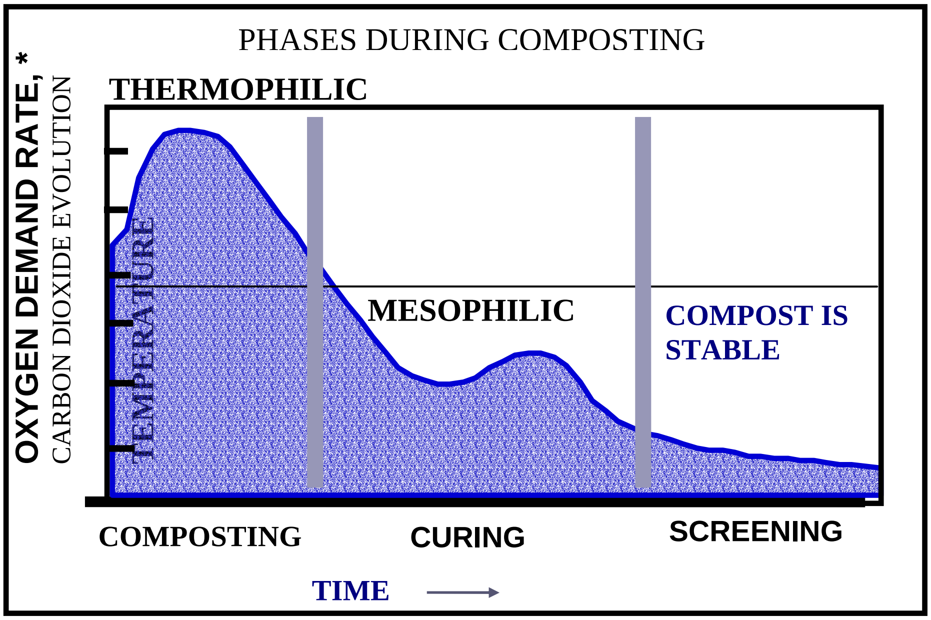
Composting is an important component of the solid waste industry. It provides resource conservation through source reduction, recycling, and reuse. However, as with other industrial processes, composting produces air emissions that are currently uncontrolled. In terms of air quality, composting is an exothermic process that releases carbon dioxide, water vapor, and other organic and inorganic gases such as ammonia, methane, VOCs, amines, and sulfides. The emissions impacts of composting are presented in the emission inventory section of this report.

From an industrial perspective, composting is a three-stage process that begins as soon as appropriate materials are combined and piled together. The initial stage of the process is referred to as active composting followed by curing or finishing, and storage and/or processing of composted products.

During the composting process microorganisms such as bacteria, fungi, and actinomycetes, consume oxygen while feeding on organic material such as wood/greenwaste, food-waste, livestock manure, sewer sludge (the semisolid residue of domestic sewage treatment processes) and other putrescible materials. The microbial activity results in the decay of the initial mixture and at the completion of the composting cycle wastes are transformed into a stable, pathogen-free composted material.

The microorganisms that contribute to the composting process contain both thermophilic and mesophilic species. Themophilic and mesophilic microorganisms are microorganisms that can sustain life under high (110-150 ^{o}F) and low (50–105 ^{o}F) temperatures, respectively. The type of microbial activity present can characterize the active and curing stages of the composting process. Active composting is where the thermophilic microorganisms' population is the highest. This stage is characterized by high temperatures, high level of oxygen demand and high evaporation rates due to temperature. Conversely, the curing stage of the process is where the mesophilic microorganism population is the highest and the need for oxygen and the evaporation rates decreases. There is also a linkage between the microbial activity and the VOC emissions profile from composting operations. Specifically, emissions can be correlated to the activity of these microorganisms in that the emissions are generally higher during thermophilic temperatures and lower during mesophilic temperatures. Figure 1-1 illustrates the oxygen demand and microbial profile of the various composting stages. This figure can be used to illustrate the corresponding VOC emissions.

Figure 1-1
PHASES DURING COMPOSTING



This graphic was provided by Eliot Epstein, Ph.D. Chief Environmental Scientist, Tetra Tech, Inc.

*VOC emissions are expected to follow the similar profile as oxygen demand.

As stated before, it is the ability to control the physical and chemical characteristics of the process that makes composting a viable industrial process. Following is a description of the main characteristics that are optimized in an industrial composting process.

Carbon-to-Nitrogen ratio (C:N) represents the weight of decomposable carbon to the weight of total nitrogen in an organic material. Carbon and nitrogen are two fundamental elements for microbial activity. Microorganisms utilize carbon for energy and growth, and nitrogen for protein and reproduction. C:N ratio is significant to the composting process because insufficient nitrogen (higher ratio) will limit microbial growth, but excess nitrogen (lower ratio) will generate ammonia or other compounds that cause odors. For the best composting, the recommended C:N range from 25:1 to 40:1, and a ratio of 30:1 is ideal. C:N ratio can be adjusted by adding organic materials high in nitrogen such as grass, sewage sludge, or animal manure, or by adding materials high in carbon such as leaves. Using commercial fertilizer as nitrogen supplement is not recommended because it will modify salt concentration in the compost and impede microbial activity.

Moisture content is the water portion of the material's total weight, expressed in a percentage. Moisture is an essential part of composting. It allows microorganisms to move about and transport nutrients, as well as provides the medium for chemical reactions. Insufficient moisture content will lead to microorganisms entering a dormant stage. Excessive moisture will limit air movement to and in the compost pile, causing an anaerobic decomposition that generates unpleasant odors. In addition, excessive moisture will also result in leachate. Since moisture content decreases as composting proceeds, a starting moisture content of 40% to 60% is recommended, and 50% to 60% is considered to be ideal. Usually, a mixture that feels moist, like a well-wrung sponge, indicates sufficient moisture. Moisture content can be adjusted either by adding water or moisture-rich organic materials, such as liquid sewage sludge, or by adding dry bulking agents such as leaves or wood chips.

Oxygen is critical to composting, especially during the early stage when microorganisms rapidly metabolize and grow. Insufficient oxygen supply will slow down the composting process and lead to an anaerobic decomposition that generates obnoxious odors, and ammonia and VOC emissions. Excess oxygen (or air) will also lower the pile's temperature slowing down the composting rate. Oxygen concentration fluctuates in response to the microbial activity. Usually, at the beginning of the composting process, oxygen concentration within the pore spaces is identical to oxygen concentration in the air (about 15% to 20%). However, as the compost ages, the oxygen concentration decreases and carbon dioxide concentration increases. A 5% to 15% oxygen concentration must be maintained for fast, aerobic composting. Oxygen (or air) can be provided by mechanical turning or by forced aeration, where air is either drawn or forced through the compost pile.

Temperature is an important aspect of composting since composting occurs within two temperatures ranges, known as mesophilic (50^{o}F to 105^{o}F) and thermophilic (over 105^{o}F). Thermophilic temperatures are preferred because they promote rapid composting, and destroy pathogens, weed seeds, as well as fly larvae. However, extreme temperatures (above 160°F) will kill most of the active, important microorganisms. According to composting experts, temperatures in the range of 110°F to 150°F are best for composting. The U.S. EPA requires that a minimum temperature of 131°F be maintained for several days to eliminate bacteria and pathogens. Usually, adding external heat is unnecessary because during the composting process, heat is generated by microorganisms and is accumulated due to the pile's self-insulation. To prevent the temperature from rising to an extreme level that creates a fire hazard, frequent aeration is necessary.

<u>pH</u> value indicates the level of acid or base in the compost. pH value is critical to composting since it affects the nutrient and metabolism of the microorganisms. Microorganisms consume organic acid very quickly; however, the majority of them can not survive an extreme acidic environment (i.e., where the pH value is far less than 7). According to composting experts, optimum pH values range between 6.5 and 8.0. Increasing the pH value by the addition of lime or other additives is not advised because of the potential ammonia loss. pH values above 8.5 encourage the conversion of nitrogen compounds to ammonia, creating an odor problem. pH value changes during the composting process, and it can be adjusted by aeration or through a natural process called carbonate buffering. Through the carbonate buffering process, carbon dioxide combines with water to produce carbonic acid that will lower the compost pH. As a result, the final compost product always has a stable, close to neutral pH value.

<u>Particle size</u> affects the efficiency of the composting process. Generally, microbial activity occurs on the surface of the particles. Therefore, an increase in the surface area by using smaller particles will increase the rate of decomposition. However, smaller particles also reduce the porosity, which is a measurement of the air space within the composting mass. This can result in poor aeration and increased emissions. Good particle sizes range from 1/8 to 2 inches average diameter and can be achieved by chopping, shredding, mowing, or breaking up the materials.

<u>Pile structure</u>, in particular the mixing of materials, size and shape are important to start off the composting process properly. The materials to be composted must be thoroughly blended to evenly distribute moisture, porosity, and C:N ratio. A compost pile must be well constructed to prevent rapid dissipation of heat and moisture, yet allow good air circulation. The pile should be at least 3 ft x 3 ft x 3ft (1 cubic yard) to keep sufficient heat, but not larger than 5 ft x 5 ft x any length so air can diffuse to the center of the pile. Some composting system use forced air or mechanical turning to compensate for larger size piles.

<u>Feedstock</u> also affects the composting process. One of the most important aspects of feedstock is how it affects the C:N ratio of the compost pile overall. Some feedstocks, like grass clippings, digested sewer sludge and food waste are higher in nitrogen content, while tree limbs and wood scraps are lower in nitrogen content. As such, waste materials are blended to achieve an optimum C:N ratio and decomposition rate. For the purpose of this rule, the composting industry has been divided into two main categories based on feedstocks handled: co-composting and

greenwaste composting. Co-composting uses putrescible feedstock materials including, but limited to, sewer sludge, cow and horse manure, and food waste combined with bulking agents like greenwaste or wood chips. The feedstock comes from sewage treatment plants, dairies, horse stables, restaurants, etc.

Greenwaste composting only uses greenwaste feedstock materials such as wood, leaves and related raw materials. The feedstock comes from landscape maintenance activities, construction sites, agriculture, curb side recycling programs, etc. One of the primary factors affecting greenwaste supply from curb side recycling programs is the level of contamination (i.e., mixing of yard waste with other trash). The level of contamination varies widely among curb side recycling programs and is influenced by the amount of public outreach, the containment method, and frequency of pick-up.

Products Produced

Composted products are used in many applications depending on the characteristics of the raw materials and the quality of the product produced. In general, high quality compost may be used in agriculture, horticulture, landscaping and home gardening. Composting facilities that use sewer sludge as a feedstock generally rate the quality of their compost as high. Medium quality compost can be used in applications such as erosion control and roadside landscaping. Low quality compost can be used as a landfill cover or in land reclamation projects. In southern California, most of the composting products are used in agricultural and horticultural operations. Smaller markets for composting products include municipal, Caltrans, local residents, etc. Most composting facilities make between one and five different composting products. Some compost facilities also provide specialized services including special product blending, spreading, bagging and delivery.

CHIPPING AND GRINDING ACTIVITIES

The chipping and grinding component of the composting and related operations industry include operations that are dedicated mainly to the mechanical size reduction of greenwaste. Mobile chippers and/or tub grinders are used to shred the green material. Sometimes the equipment is connected to screens and magnetic separators to produce certain end products and improve the quality of the end product. These operations chip and grind greenwaste such as tree trunks, residential and commercial landscaping, curbside green-waste recycling, and debris from construction sites. The chipped and ground material produced is then used as an alternative daily cover (ADC) at landfills, fuel in waste-to energy facilities, mulch, raw material for greenwaste composting, or bulking agents for co-composting operations. Chip and grind operations can be a stand-alone operation or a part of a composting facility.

Business Structure

Composting and chipping and grinding facilities generate income from two sources. First, these facilities charge haulers “tipping” fees when they drop off the raw feedstocks. Second, these facilities sell the final products (e.g., compost, fuel for waste-to-energy plants, mulch, etc.). Tipping fees vary across the state. Table 1-1 provides a summary of tipping fees throughout California from a study sponsored by the CIWMB in 2000. The study indicates that southern California has lower tipping fees than northern California.

Table 1-1
Solid Waste Tipping Fee Survey of California

Region	Average Tipping Fee (per ton)
Northern	$58.49
Bay Area	$47.73
Central Coast	$39.21
Central Valley	$35.79
Southern (includes SCAB)	$35.42

In the SCAB, based on staff survey, tipping fees for greenwaste range from $10 to $15 per ton and tipping fees for sewer sludge range from $30 to $40 per ton. If the material was landfilled, the tipping fee would be $30 per ton.

The sale price of compost varies widely and competes with fertilizers. Composting facilities generally sell their final compost product for around $30 per ton. Very high quality and specialty compost can command a price of $90 a ton. Chipping and grinding facilities sell a final product like fuel for waste-to-energy plants for about $10 per ton.

For facilities that compost by windrowing the feedstock (which is the dominate method in the SCAB) operational costs include leasing unimproved land, leasing equipment (i.e., grinders and front-end loaders), and low-skilled labor. These operations are generally not labor intensive. An average size composting facility has 5 to 10 employees. Operational costs are higher for facilities that transport their final products since they incur additional costs for trucks and drivers. Generally, these cost are recouped by having the customer pay shipping costs. Chippers and grinders incur similar costs to composting facilities.

Sanitation agencies that do not currently compost sewer sludge incur costs for disposing of the sludge by land spreading. These agencies must pay for the sludge to be transported (to Kerns, Kings, and/or Riverside Counties). Currently the transport cost including labor and tipping fee is approximately $38 per ton and is expected to increase if the disposal site is further away from the SCAB.

OVERVIEW OF CURRENT REGULATORY REQUIREMENTS

There are three levels of regulatory requirements that apply to the composting and chipping and grinding industries: 1) federal requirements (i.e., U.S. Environmental Protection Agency or EPA; 2) state (i.e., the California Air Resources Board (CARB) and the California Integrated Waste Management Board (CIWMB)), and, 3) local (i.e., the AQMD, local governments, and local enforcement agencies). Each of these agencies' regulatory structure is designed to deal with different issues and while not necessarily driven by air issues some may indirectly benefit air quality. None of the existing regulations directly address air quality impacts from these operations. The following is an overview of federal, state and local regulatory programs that are applicable to the chipping and grinding and composting industries.

Federal Requirements

The federal Clean Air Act requires the AQMD to adopt an AQMP that identifies a control strategy to demonstrate compliance with the federal ambient air quality standards. To address this federal mandate, the 1997 AQMP and 1999 Amendments to the 1997 Ozone State Implementation Plan for the SCAB included Control Measure WST-02 – Emission Reductions from Composting. The U.S. EPA approved these plans making the development of this control measure federally enforceable. In addition to air quality issues, there are other federal requirements that apply to composting operations. Specifically, the federal requirements focus mainly on water and solid waste (i.e., sewage sludge) issues. The following is a brief summary of these requirements.

<u>Resource Conservation and Recovery Act</u>

In 1976, Congress enacted the Resource Conservation and Recovery Act (RCRA), an amendment to the 1965 Solid Waste Disposal Act. RCRA calls for conservation of energy and natural resources, waste reduction, and environmentally sound waste management practices. In addition, RCRA encourages states to develop plans for non-hazardous industrial solid waste and municipal solid waste (MSW) management, sets criteria for MSW landfills, as well as for other solid waste disposal facilities, and prohibits the opening dumping of solid waste. Congress delegated authority to U.S. EPA to develop specific regulations to implement the requirements of RCRA. Solid waste regulations have been promulgated in the Code of Federal Regulations under Title 40, Chapter I, Subchapter I, Parts 240-282 (40 CFR Parts 240-282). As a result of RCRA's prohibition on open dumping of solid waste other disposal alternatives for sewage sludge has been pursued including land spreading (treated sludge is spread over crop land as fertilizer), aerobic digestion, and composting.

<u>National Pollutant Discharge Elimination System</u>

The National Pollutant Discharge Elimination System (NPDES) is an EPA-implemented program that requires permits for discharging pollutants from facility operations into water[3]. Even though the NPDES program focuses on water pollution from all types of industries, NPDES also applies to owners or operators of facilities that treat and handle sewage sludge, including composting with sewage sludge. The criteria and standards for NPDES are quite extensive and have been promulgated in several parts of the Code of Federal Regulations under Title 40, Chapter I, Subchapter D, Parts 122, 123, 124 and 125 (40 CFR Parts 122–125).

<u>Sewage Sludge Disposal Standards</u>

EPA promulgated standards for the use or disposal of sewage sludge in Title 40, Chapter I, Subchapter O, Part 503 of the Code of Federal Regulations (40 CFR Part 503). 40 CFR Part 503 contains requirements for the control of pathogens, vectors, and heavy metal for sludge composting operations. In particular, to qualify as Class A compost Appendix B to Part 503-Pathogen Treatment Processes, generally requires processes to further reduce pathogens (PFRP). PFRP requires that open windrow composting maintain the temperature of the compost to be 55^0 C or higher for 15 days or longer, and during this time there must be a minimum of 5 turnings of the

[3] 40 CFR Part 122, §122.1 (b).

windrows. For in-vessel or aerated static pile (ASP) composting, the PFRP requires the active pile temperature be at least 55^0 C or higher for 3 days.

State Requirements

State law also requires the AQMD to adopt an AQMP that identifies a control strategy to demonstrate progress towards achieving the state ambient air quality standards. The 1997 AQMP and 1999 Amendments to the 1997 Ozone State Implementation Plan for the SCAB that included Control Measure WST-02 – Emission Reductions from Composting, was also submitted to the CARB to comply with state law. These air plans identified composting as a source of ammonia, PM10, and VOC emissions. As such, Control Measure WST-02 required the development of viable control to reduce the emissions from this industry by 2003. In addition to air quality requirements, there are several other state requirements that may apply to chipping and grinding and composting operations. Specifically, these state requirements focus on air, water and solid waste (i.e., sewage sludge) issues. The following is a summary of these requirements.

<u>California Air Resources Board</u>

In addition to reviewing and approving the AQMP, CARB permitting requirements can affect composting and chipping and grinding operations that use portable equipment. As of December 1, 1999, CARB runs the “Statewide Registration Program” which regulates portable engines and portable engine-driven equipment units. Once equipment is registered in this program, engines and equipment units can operate throughout California without the need to get individual permits from local air pollution control districts, such as the AQMD. The AQMD is preempted from permitting, registering, or regulating portable engines and portable equipment units properly registered with the CARB.

Owners and operators of portable engines and portable equipment units that meet the definitions and requirements of the registration program are eligible for statewide registration. Facilities that conduct chipping and grinding or composting activities operate portable engines that are affiliated with equipment, including but not limited to, wood chippers, tub grinders and trommel screens. It is common for these types of facilities to have equipment operating pursuant to Statewide Registration Permits.

<u>California State Legislature: California Integrated Waste Management Act</u>

Recognizing the need for integrated waste management practices, in September 1989, the California state legislature passed Assembly Bill (AB) 939 – California Integrated Waste Management Act, into law, which was incorporated into the California Public Resources Code, Division 30, §40000 et seq. (Division 30). Division 30 is implemented by CIWMB. Section 41780-41786 of the law contains mandates for cities and counties to achieve a total waste diversion of 25 percent by 1995, and a total waste diversion of 50 percent by 2000, as established by a 1990 baseline. Division 30 also requires California to secure and plan for adequate long-term disposal capacity. Since organic materials, such as food and greenwastes, represented approximately 25 percent of California’s waste stream in 1999, recycling, reuse, and source reduction have been widely promoted to achieve the goals of Division 30.

California Integrated Waste Management Board

In June 1995, the CIWMB promulgated a set of regulations governing composting operations and facilities. The CIWMB currently regulates approximately 87 composting facilities operating in California in accordance with the California Code of Regulations, Title 14, Division 7, Chapter 3.1 – Composting Operations Regulatory Requirements (Chapter 3.1). Depending on the type of composting materials and the throughputs, affected facilities are required to obtain a Registration Permit, a Standardized Composting Permit, or a Full Solid Waste Facilities Permit (Full Permit). Full Permits require the preparation of an Environmental Impact Report (EIR) and are issued by CIWMB while Registration and Standardized Permits are issued through local enforcement agencies (LEAs), such as the environmental health departments. According to the CIWMB data-base, sixteen of the twenty-seven facilities in the AQMD's jurisdiction are identified as having a CIWMB permit.

Currently, the CIWMB is revising these regulations to address a number of issues relating to composting activities including an increasing number of complaints regarding odor at compostable organic materials transfer/processing operations and facilities. The CIWMB's staff is concerned that continued problems with odors could limit the growth of the composting industry. As such, the CIWMB is proposing to revise its regulations to require odor minimization plans developed by the composting facilities. The odor minimization plans would be reviewed only if there exists a documented public nuisance. While odors are under the regulatory oversight of the jurisdiction's local enforcement agency, odors are an indication that the piles are emitting ammonia and VOCs. The AQMD retains authority over emissions from these facilities.

Though chipping/grinding facilities are not currently required to obtain permits, CIWMB is developing a proposal to amend the permit requirements in Chapter 3.1 to include chipping/grinding and other operations that handle compostable organic materials.

Regional Water Quality Control Board

The Regional Water Quality Control Board (RWQCB), a state agency with regional offices throughout California, enforces EPA-issued National Pollutant Discharge Elimination System (NPDES) permits. In addition, the RWQCB focuses on wastewater generation, water demand, the capacity of existing or planned stormwater drainage systems and potential new sources of polluted run-off, and potential depletion of groundwater supplies or interference with groundwater recharge. In the case of composting and chipping/grinding facilities, the RWQCB has required various sites to be graded, paved, and surrounded by berms and other drainage-related protections to prevent run-off and the leaching of composted/chipped ground materials into the groundwater.

Local Requirements

There are several local requirements that may apply to chipping/grinding and composting operations. Specifically, these requirements focus on air, land use and solid waste (i.e., sewage sludge) issues. The following is a summary of these requirements.

AQMD Rule Requirements

Currently, operators of composting and chipping/grinding facilities located in the district are required to comply with AQMD Rule 402 – Nuisance, Rule 403 – Fugitive Dust, and Rule 203 – Permit to Operate for equipment that require permits. However, none of these rules require specific emission controls at composting or related facilities.

Local Enforcement Agency Requirements

There are several different local (i.e., city or county) enforcement agencies or LEAs that act as the either the permitting or enforcement division of the CIWMB, depending on the throughput and type of compostable materials. For example, the local department of health services, on behalf of the CIWMB, issues Registration and Standardized permits and enforces the requirements in these permits for facilities with lower throughputs. However, for facilities that have throughputs that require a Full Permit issued by the CIWMB, the LEA is only responsible for enforcing the requirements in the Full Permit. For either type of permit scenario, the LEAs are responsible for handling and investigating complaints from composting and chipping/grinding operations.

City or county offices in the jurisdiction where a facility is located approve or deny conditional use permits, and have the authority over land use and the siting of composting facilities, transfer stations, or other solid waste management activities.

Sewage Sludge Ordinances

In addition to EPA's federal requirements regarding the use or disposal of sewage sludge, there are local ordinances or restrictions throughout California and other states that ban the import and land application use of certain grades of sewage sludge. For example, 14 counties within California, with Riverside county being the only one located within the AQMD's jurisdiction, have passed ordinances or permitting requirements that either ban or restrict the application of certain grades of sewer sludge onto farmland[4]. In addition, recent litigation and regulations in both Kern and Kings counties have resulted in ordinances that ban the import of certain classes of sewage sludge starting early 2003. Other states such as Pennsylvania, Vermont, and New Hampshire, have also passed similar ordinances to ban or limit the application of sewer sludge onto land. These restrictions will likely force the water treatment plants within the AQMD's jurisdiction, throughout California and the nation to further process the sewage sludge so that it can be recycled and used on farmland.

Local Governments

Local government zoning and general plan standards determine where composting and chipping and grinding activities can occur. In addition, local governments grant conditional use permits if the jurisdiction has determined that special conditions and approvals are necessary. Local governments, through curb side recycling programs, may also be providing some composters with greenwaste feedstock.

[4] County of Riverside Ordinance No. 744 – Regulating the Processing of Greenwaste.

OTHER ISSUES FACING THE COMPOSTING INDUSTRY

Public Nuisance Issues

Uncontrolled emissions, odors, and dust generated by windrow composting and chipping and grinding operations are often sources of public complaints. Emissions and odors can dramatically increase if the windrows are not maintained properly or chipped and ground material is allowed to decompose. Some feedstocks like food waste, dairy products, manure, sewer sludge, are odorous. Also, some outdoor blending operations of putrescible feedstocks generate odor related public nuisance complaints. Dust may also result from open feedstock preparation areas, chipping and grinding operations, and compost turning, curing, screening, storage, and loading. The problem can be worse during high winds.

Over the last two years, *thousands* of odor and dust complaints have been filed with the AQMD and with local enforcement agencies (LEAs). In particular, between January 1, 2000 and December 31, 2001, the AQMD received 470 public complaints regarding composting and chipping and grinding operations. The LEAs have received over 2,600 complaints regarding composting and chipping and grinding operations.[5] The AQMD staff has issued notices to comply (NC) and notices of violation (NOVs). The AQMD does not have records of enforcement actions taken by the LEAs. Table 1-2 summarizes this information.

Table 1-2
2000-2001 Public Complaints/AQMD Enforcement Actions
On Composting and Chipping and Grinding Operations

Agency	# of Complaints	# of NCs/NOVs
AQMD	470	55 (30 NCs and 27 NOVs)
LEAs	2,600+	N/A

The AQMD's role in addressing public complaints from these facilities has been affected by AB 59 that become law in 1995. Under this law, all air districts in California are to refer public complaints pertaining to odors from a composting facility that is subject to the CIWMB's regulatory requirements to the LEA. Odors from non-composting activities like chipping and grinding activities, mulching, and ADC are under the AQMD's jurisdiction. Non-odor related public complaints including dust-, permitting-, or emissions-related nuisances affecting the public are within the AQMD's jurisdiction.

Waste Diversion (AB 939)

AQMD staff has received public testimony that composting is an integral program used to comply with AB 939 (the California Integrated Waste Management Act of 1989) Waste Diversion requirements. AB 939 is implemented by the CIWMB, and mandates cities and counties to achieve a 25 percent total waste diversion by the year

[5] This number underestimates the total number of complaints to LEAs because not all the LEAs maintain the data in a tabulated format and not all the composting and chipping and grinding facilities were included in the AQMD's data request.

1995, and a 50 percent waste diversion by the year 2000, based on the 1990 baseline year. Organic materials, one component of the waste stream, can be diverted from landfills through methods including use as ADC, fuel at waste-to-energy facilities, mulch, composting, soil amendments and erosion control.

AQMD staff has conducted an evaluation of the current practices in achieving the waste diversion goals of AB 939. The CIWMB measures compliance with AB 939 waste diversion goals by measuring the reduction in the amount a given jurisdiction disposes to the landfill. There is no quantifiable measurement of the quantity of waste actually being diverted. For each jurisdiction a maximum allowable disposal amount is calculated which represents a 50 percent reduction of disposed waste from 1990. To meet the diversion rate requirement, a jurisdiction may not dispose more than the maximum allowed amount. Each jurisdiction must also submit an annual report that includes information on all programs being implemented to divert waste disposal to a landfill. Organics are only one of the waste categories that is affected to achieve the AB 939 goals. Jurisdictions also promote source reduction and the recycling of paper, glass, and aluminum cans, and household hazardous waste.

The CIWMB estimates that the year 2000 statewide diversion rate is at 42 percent. As indicated above, it is unknown how much each individual waste diversion program contributes to the overall waste diversion rate. AB 939 requires each jurisdiction to prepare, adopt, and submit to the CIWMB a source reduction and recycling element (SRRE) that demonstrates how the jurisdiction will meet the CIWMB's mandated diversion goals. The CIWMB approves the information submitted by each jurisdiction, but does not keep track of each individual program's effect on diversion. It is the burden of each individual jurisdiction to show to the CIWMB that the diversion mandate is being met. While the database does not provide specific information on the amount of waste diverted from each of these programs, it does indicate an intention to divert waste by using a variety of programs. These programs include: source reduction, composting, recycling, specials waste, public education, policy incentives, facility recovery, transformation, and household hazardous waste. Recycling and source reduction are the preferred programs used by the most number of jurisdictions to achieve the targets. Recycling programs included curb-side pick up, drop-off programs and special programs. Source reduction included thrift shops, business programs, xeriscaping, and backyard composting (proposed to be exempt from PR 1133).

The CIWMB further analyzes the SRRE documents to determine waste stream characteristics. Based on a 1999 waste characterization study conducted by the CIWMB, all organics contribute about 35.1 percent to the overall waste stream. Organics include materials that are eligible for composting programs. Organics waste includes food, landscaping materials, agricultural crop residues, manures, textiles, etc. Table 103 lists a break-down of the organics-only waste stream based on the CIWMB's records.

Table 1-3
Types of Organics Contributing to Waste Stream

Organic Material Type	Percentage of Waste Stream
Food	15.7%
Leaves & Grass	7.9%
Prunings & Trimmings	2.2%
Branches & Stumps	0.1%
Agricultural Crop Residues	0.0%
Manures	0.1%
Textiles	2.1%
Remainder/Composite Organic	6.9%

Recent studies by the CIWMB show that while organics are prevalent in the waste stream, many of these organic materials are also associated with odor and emissions problems. For example, Table 1-4 indicates the top ten materials in the waste stream. Food waste makes up the highest percentage of the waste stream. The AQMD staff has received a significant number of odor complaints from composting-related activities that includes food wastes. Grass is another organic waste material that has odor problems associated with it. Grass can be an issue in greenwaste composting leading to higher emissions and odors because of its moisture and rapid decomposition.

Table 1-4
Top Ten Materials in Waste Stream

Material	Percentage of Waste Stream
Food	15.7%
Remainder/Composite Paper	9.6%
Leaves & Grass	7.9%
Remainder/Composite Organic	6.9%
Lumber	4.9%
Uncoated Corrugated Cardboard	4.6%
Other Miscellaneous Paper	4.4%
Newspaper	4.3%
Film Plastic	3.9%
Other Ferrous Metal	2.4%

There are a number of different programs being used to divert greenwaste that rely on source reduction, transformation, public education, incentive programs, and composting. These programs are listed in Table 1-5.

Table 1-5
CIWMB Identified Examples of Programs to Divert Greenwaste

Programs	Description
Xeriscaping, grasscycling	Landscaping to reduce waste
Backyard composting	Composting at home by residents
Mulching	Gardening product
Seasonal Collections	Holiday foliage
Commercial Composting	Creation of commercially sold gardening products
Alternative Daily Cover	Substitute cover for soil at landfills
Fuel	For waste-to-energy facilities
Bulking agent	For use in co-composting of sewer sludge, food waste, manure
Landfill ban on greenwaste	Not accept greenwaste
Tipping fee incentives	Structure fees to benefit source reduction
Collection rate incentives	Structure fees to benefit source reduction
School composting	Composting conducted at schools with on-site materials

A review of the CIWMB's database on local government's SRRE's indicates ADC appears to be an important program currently being using to achieve the AB 939 diversion targets. For example, in the facility recovery component of the SRRE, approximately 58 local governments (in the four counties) indicated that they rely on a composting facility program, while approximately 103 local governments indicated they rely on ADC programs.

A study was also conducted by the CIWMB to assess California's compost and mulch producing infrastructure. The study analyzed both composters and processors (i.e., process material, but do not compost). The surveys of the chippers and grinders are good general indicators of the types of programs being relied upon to divert greenwaste from landfills for several reasons. All the greenwaste that is diverted from landfills must be processed (i.e., chipped and ground) before it can be put to other uses, including the greenwaste collected by local jurisdictions in curb-side recycling programs. The chippers and grinders in the survey are stand-alone operations that do not compost on site, so it is good indication of the overall market demands for processed greenwaste.[6] There are more chippers and grinders (47) than composters (28) in the AQMD's jurisdiction and the chippers and grinders handle 3 times more greenwaste than the composters. This study (focusing on the chippers and grinders data) indicates that in southern California alternative daily cover (ADC) is the most heavily relied upon method jurisdictions use to divert greenwaste from landfills (46%), followed by fuel for waste–to-energy facilities (25%), and then composting (18%). The study also acknowledged that southern California's use of ADC leads other regions in California. Even when the composters' product distribution is considered, ADC and fuel are still important to waste diversion.

[6] The survey of the chippers and grinders was viewed as a better overall indicator of the markets since chippers and grinders facilities serve as the first stage in the diversion process. For example, chippers and grinders provide raw feedstock to composters. Therefore, using composter data may result in double counting of product markets. Further, any chipping and grinding performed by the composters is primarily for processing composting-related products and not as reflective of the other markets for processed green waste.

Composters in southern California produce compost (50% of their products), ADC (16%), fuel (6%), and mulch (13%).

The AQMD staff conducted a survey of composting and related facilities in the region. The composting facilities and most of the chipping and grinding facilities were visited by AQMD staff and the surveys completed as part of that visit. Surveys were also mailed to other facilities and some facilities were surveyed over the telephone. Part of the AQMD's survey included collecting information on the amount of greenwaste that was being composted in the AQMD's jurisdictional boundaries. The AQMD's survey of the chipping and grinding and composting facilities supports the finding that ADC and fuel for waste-to-energy facilities are key programs being relied on by local governments in general for achieving the AB 939 waste diversion goals. Based on this survey, the AQMD staff also determined that the total amount of greenwaste used either as a bulking agent for co-composting or at a greenwaste composting facilities was approximately 1.1 million tons a year. Of the 3 million tons of material processed at chipping and grinding facilities, approximately 15-40% of the material is used for waste-to-energy, 50-60% for ADC, and 10% for mulching or composting.

The prevalence of ADC as a key program for greenwaste diversion is also recognized by the CIWMB. The CIWMB has summarized the reported waste-derived ADC since 1996 in Table 1-6.

Table 1-6
CIWMB Statewide ADC Analysis (tons/year)

ADC Type	1996	1997	1998	1999	2000
Green Material	560,266	625,198	1,083,673	1,396,026	4,302,443[7]
Other (mainly Sludge; Treated Auto Shredder Residue; C&D)	383,669	659,339	587,285	791,786	666,042
Total ADC	943,935	1,284,537	1,670,958	2,187,812	4,968,485
ADC % of Total Disposal	3.0%	3.5%	4.5%	5.5%	15%

Based on available data, AQMD staff has not been able to quantify the extent to which these programs are actually being utilized to achieve the AB 939 waste diversion goals. There are no records that indicate which programs are the most important to achieving the AB 939 waste diversion goals. Therefore, a qualitative assessment of surveys and other information has been conducted to determine the relative importance of each program in diverting waste.

To further address the waste problem in California, the CIWMB is exploring conversion technologies that would convert organic materials, including greenwaste, into high-value products like energy, alternative fuels (ethanol), solvents, and other products. These technologies include hydrolysis, gasification, and anaerobic digestion. Hydrolysis is the chemical decompostion process that uses water to split the chemical bounds of substances. This process can be used to create products such

[7] Preliminary amounts. CIWMB Staff is currently reviewing revised DRS reports from counties.

as ethanol, specialty chemicals, fuels, and citric acid for the beverage industry. Gasification is a process that uses heat, pressure, and steam to convert materials directly into a gas composed primarily of carbon monoxide and hydrogen. The products from this process can be used as a fuel to generate electricity or a gasoline additive. Anaerobic digestion is the biological decomposition of matter in the absence of oxygen and is used to produce compost, fertilizer, and methane. The emissions from all of these processes are controlled unlike the emissions from windrow composting.

The CIWMB is currently analyzing the regulatory issues surrounding the use of conversion technologies including permitting, public health standards, and diversion credits. The current law allows for 10 percent of the diversion credit to be met by these transformation technologies if certain requirements are met.

Regardless of the fact that composting does not appear to be as highly relied upon as other programs, the AQMD staff is cognizant of the AB 939 requirements on local governments and is striving to draft a regulatory program that would not adversely affect AB 939, while achieving clean air objectives. For this reason, AQMD staff has focussed its efforts in identifying and quantifying the impacts to the specific industries affected by the proposal.

Environmental Justice

In California, environmental justice is generally considered to be a call for the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws and polices. In October 1997 the AQMD Governing Board adopted an environmental justice policy. The four guiding principles are:

- All basin residents have the right to live and work in an environment of clean air, free of airborne health threats;
- Government is obligated to protect public health;
- The public and private sectors have the right to be informed of scientific findings concerning hazardous and toxic emission levels, and to participate in the development and implementation of adequate environmental regulations in their communities; and
- The (AQMD) governing board is to uphold the civic expectation that the public and private sectors of the basin will engage in practices that contribute to a healthy economy and truly livable environment."

Environmental justice can be an issue in the siting of composting operations because of odors and dust impacts on neighborhoods from uncontrolled operations. The number of public nuisance complaints that the AQMD and LEAs have received regarding composting and related activities shows that these operations are having an impact on the surrounding community. As such, regardless of air quality regulations, environmental justice issues will affect the ability for future expansion of composting operations unless these issues can be adequately addressed. Controls to reduce emissions are expected to go a long way in addressing these impacts and would be consistent with the AQMD’s environmental justice policy.

Regulatory Limits on Land-Application of Wastewater Sludge

Currently, sewer sludge that has been treated to reduce pathogens and metals is trucked from this region to Kings and Kern Counties where it is spread on croplands. Sewer sludge enriches the soil and can supplement or replace commercial fertilizers. There are two classes of processed sludge. Class A sludge must undergo pathogen reduction to be below detectable levels. Class A can be used on edible vegetables and plants. Class B sludge must undergo pathogen reduction to ensure the pathogens are reduced to levels that are protective of public health and the environment. Class B sludge is only used on non-edible crops, forests, and reclamation sites. Class B sludge can not be used for composting. Public concerns over Class B sludge used on croplands in Kings and Kern Counties has resulted in these jurisdictions placing limitations on Class B sludge. As a result, additional options to deal with the Class B sludge will need to be developed. This could include additional composting of sludge in the region if the sludge is treated to Class A levels. Therefore, there is an increased need to resolve the environmental impacts issues associated with co-composting operation so that additional co-composting facilities can be sited in the AQMD's jurisdiction. The majority of the co-composting facilities in the region have already indicated that they will enclose active composting and vent emissions to a control device.

NECESSITY FOR PROPOSED RULE 1133

PR 1133 was developed to fulfill the AQMD's commitment in the 1997 AQMP and 1999 Amendments to reduce ammonia and VOC emissions from composting and related operations. As such, this rulemaking is part of an integral plan to achieve healthful air in the region. Currently, the manner in which composting is conducted by windrows results in a source of VOC and ammonia emissions. Composting is also a source of numerous public nuisance complaints regarding dust and odors. The former would be addressed by this rulemaking. Various control techniques have been applied to bio-solid composting throughout the U.S. to reduce emissions and public nuisance complaints. This report examines viable control options for the local composting industry.

CHAPTER II

INDUSTRY PROFILE AND EMISSIONS INVENTORY

INTRODUCTION

This chapter discusses the following:

- ✓ Industry Profile; and,
- ✓ Emissions Inventory.

INDUSTRY PROFILE

The AQMD staff developed an industry profile for the composting and related operations industry based on information obtained from the CIWMB permit database, AQMD permit system, AQMD-conducted surveys and site visits, and comments from the public. Through this process, the AQMD staff identified 277 facilities. For the purpose of rule development, the facilities that make up the composting and related operations industry are classified into four categories: 1) co-composting facilities; 2) greenwaste composting facilities; 3) chipping and grinding facilities; and, 4) exempt facilities.

Co-composting facilities include facilities that compost putrescible materials such as, sewage sludge, manure, and food wastes in combination with greenwaste. Greenwaste composting facilities are composting facilities that use only greenwaste as feedstock materials. Chipping and grinding facilities are facilities that chip and grind greenwaste for use in composting, waste-to-energy, and alternate daily recovery (ADC) at landfills, or to produce mulches. Finally, exempt facilities are those facilities that are categorically exempt from Proposed Rule 1133 based on the type of operation (i.e., transfer station/MRF, sewage treatment, fertilizer blending/bagging, manure shredding, landscaping/nursery/gardening, agricultural farm composting, winery, community composting, portable chipping/grinding, botanical garden/arboretum, and public park/camping.)

Facility and throughput information was compiled based on information obtained from the CIWMB, the AQMD Permit System, the AQMD-conducted surveys and site visits, and independent contractor's studies.

Table 2-1 - Composting Industry and Related Operations, provides a profile of the composting and related operations industry.

Table 2-1
Composting Industry and Related Operations

CATEGORY	Number of Facilities	Throughput (tons/year)
Co-Composting	12	922,190
Greenwaste-composting	16	832,191
Chipping/Grinding	47	3,033,092
Exempt Facilities	202	36,865
Total	**277**	**4,824,338**

The geographical distribution of the composting and related operations industry is approximately 42, 19, 16, and 23 percent for Los Angeles, Orange, Riverside, and San Bernardino counties, respectively. Table 2-2, Composting Facilities by County, provides number of facilities and throughputs in each of the counties by industry sector.

Table 2 – 2
Composting Facilities by County

Category	Number of Facilities by County (Throughputs – tons/year)			
	Los Angeles	**Orange**	**Riverside**	**San Bernardino**
Co-Composting	3 (18,570)	2 (38,329)	1 (365,000)	6 (500,291)
Greenwaste-composting	6 (52,516)	3 (240,490)	4 (189,745)	3 (349,690)
Chipping/Grinding	20	9	13	5
Exempt Facilities	87	39	26	50
Total	116	53	44	64

EMISSIONS INVENTORY

The 2001 baseline emissions inventory for the composting and related operations industry includes emissions from 12 co-composting and 16 greenwaste composting facilities operating in the AQMD's jurisdiction. Emissions for co-composting and greenwaste composting were estimated by multiplying the facilities' annual throughput with facility-wide average emission factors. For all but two facilities that compost in an aerated static pile (ASP) and an in-vessel system, the emissions are considered to be baseline emissions representing the existing setting and do not take into consideration future plans. In addition, the inventory includes emissions from the exempt facilities. This inventory therefore, represents the existing settings. The emissions inventory does not include PM10 emissions from fugitive dust at any of the facilities including chipping and grinding operations. From work on similar facilities (Rules 1158, 403, 1186), public nuisance complaints, and site visits, the AQMD staff believes that there are PM10 emissions from these operations. As such, the total air quality impact of this industry is underestimated.

Emission Factor Development

The emission factors used for the development of the inventory are based on field measurements that were conducted by the AQMD's Technical Services Division. Specifically, field measurements were conducted at four co-composting facilities including, three outdoor windrow co-composting facilities and one in-vessel composting facility. The AQMD staff also conducted tests at one greenwaste composting facility. Complete source test reports are available from the AQMD.

In general, the field measurements conducted included several samples in order to develop an emissions profile that would be reflective of different phases of the composting process (i.e., active composting and curing). The following section provides more information on the development of the emission factors and emissions profiles for co-composting and greenwaste composting only.

Emission Factors for Co-Composting

In 1995, as part of the PM10 Technical Enhancement Program (PTEP), the AQMD staff conducted an emission evaluation of four co-composting facilities, using the EPA approved Emission Isolation Flux Chamber method. The following summarizes the results of the source tests. Full source test reports are available from the AQMD.

Based on the PTEP data for three windrow co-composting facilities, the AQMD staff developed the emission factors used to estimate ammonia and VOC emissions from co-composting operations. Only data from the windrow type of operations were used since the windrow composting method represents the current state of the industry, and this method of composting is considered to be the source of baseline emissions. The estimated emission factors for ammonia and VOC are 2.93 and 1.78 lb/ton mix, respectively. The estimated emission factors were calculated as the arithmetic average of data presented in Table 2-3 – Windrow Emissions Factors.

Table 2-3
Windrow Emissions Factors

Facilities	NH3 E.F. (lb/ton mix)	(VOC) E.F. (lb/ton mix)
RECYC Inc. @ Corona (1995)	2.7	0.53
EKO System @ Corona (1996)	3.28	1.7
San Joaquin Composting, Inc. @ Lost Hills (1996)	2.81	3.12
Average	**2.93**	**1.78**

The emission factors presented in Table 2-3 are the weighted-average emissions factors for emission rates from different compost piles at different days in the cycle. The source tests used for this analysis contain data from the second day through the sixtieth day of composting cycle.

Based on the available source test data, EPA's pathogen reduction 15-day requirement, and information from other studies, for emissions purposes, staff assumed that the active phase of the composting cycle takes approximately 22 days. The active composting phase of the process is the time period where organic material decomposes at its fastest rate and emissions are generated at a high rate.

The 22-day assumption is anecdotally supported by information found in EPA 503 regulations and other studies found in the literature. In particular, an odor-emission study on manure composting conducted by University of Minnesota demonstrates that odor emissions generated from 3-day piles are at least six times greater than odor emissions of 28-day piles. By way of example, Figures 2-1 and 2-2 provide a graphical representation of the composting process, based on the source test conducted. These figures representing methane and ammonia emissions over time, which are consistent with AQMD staff assumptions on the emissions split time period for the active and initial curing phases of the composting process.

Figure 2-1 - Methane Emissions vs. Time

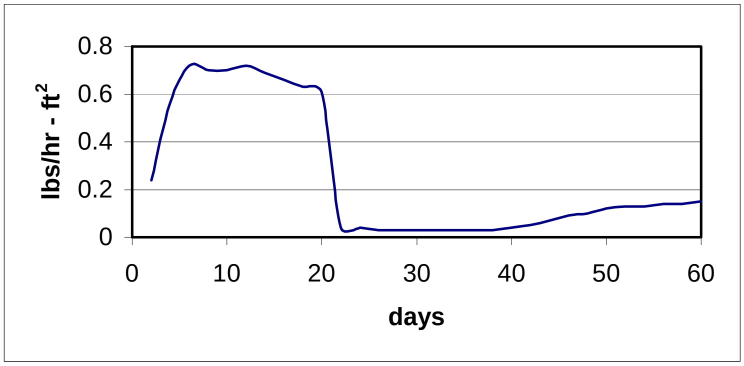
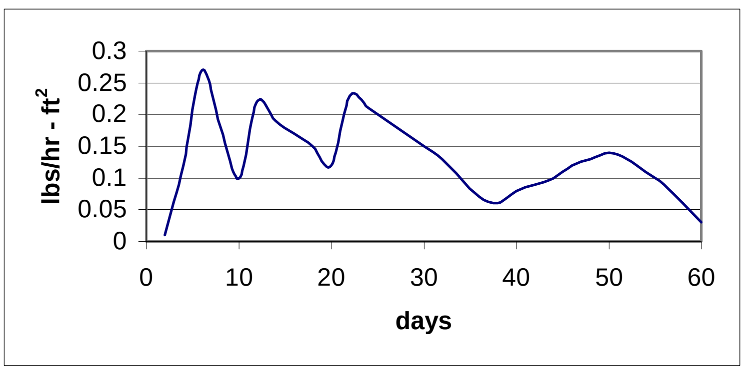


Figure 2-2 - Ammonia Emissions vs. Time



Furthermore, PTEP data was also used to determine the emissions distribution for the co-composting process. The weighted-average emission factors of composting piles up to 22-days old were used to calculate the emission factors for the active phase of composting process. The weighted-average emissions factors of composting piles up to 60-days old were used to calculate the emission factors for the curing stage of the process.

Based on the 22-day assumption, staff analysis indicated that, for ammonia, 50% of the emissions are released during the active phase and 50% of the emissions are released during the curing phase of the process. For VOC, staff analysis indicated that 80% of the emissions are released during active phase and 20% of the emissions are released during the curing phase of the process.

Based on the results of emissions profile analysis, the estimated ammonia emission factor for both active and curing phases of the process is equally estimated to be 1.47 lb/ton mix. For VOC, the estimated emission factors are 1.42 lb/ton mix and 0.36 lb/ton mix, for the active and curing phases, respectively.

Emission Factors for Greenwaste Composting

The AQMD staff conducted two source testing for greenwaste in September and November-December of 2001. Based on the weather conditions, the September and November-December tests are referred to as early fall and early winter tests, respectively. The early fall test was conducted using the EPA approved Emission Isolation Flux Chamber method. The early winter test was conducted using a remote sensing measurement technology called Boreal Laser Gas Finder. Basically, this technique measures the concentration and the volumetric airflow rate through large cross sections of the pile. The results of the cross section analysis are used to provide an estimate of emissions from the entire pile. For the purpose of this analysis, both early fall and early winter test results were used to develop the weighted-average emission factors for greenwaste composting. The early fall source test report is available upon request, and the early winter source test report will be available shortly.

The following summarizes the results of AQMD staff's greenwaste composting source tests and the development of related emission's factors.

Early Fall Source Testing

The early fall test was conducted on four piles that were approximately 2-day, 14-day, 45-day, and 70-day-old. Different age piles were tested to ensure representation at various stages of the composting process.

To obtain the composite samples, testing was also conducted at various positions (up to ten positions) of each pile. The results of the composite sample's emission rates are presented in Table 2-4 – Composite Emission Rates (Early Fall Test).

Table 2-4
Composite Emission Rates (Early Fall Test)

	2-day Pile	14-day Pile	45-day & 70-day Pile
NH_3 Emission Rate (lb/hr•1000 ft^2)	0.091	0.071	0.004*
VOC Emission Rate (lb/hr•1000 ft^2)	0.368	0.226	0.079*

(*) Average of two piles

The above emission rates were then used to estimate the emission factors presented in Table 2-5 – Composite Emission Factors (Early Fall Test).

Table 2-5
Composite Emission Factors (Early Fall Test)

	2-day Pile	14-day Pile	45-day & 70-day Pile
NH_3 Emission Factor (lb/ton greenwaste)	0.69	0.61	0.02
VOC Emission Factor (lb/ton greenwaste)	2.8	1.95	0.3

Based on previously described 22-day active phase assumption, the estimated active and curing emissions factors for greenwaste composting are presented in Table 2-6 – Emission Factors for Greenwaste Composting (Early Fall Test).

Table 2-6
Emission Factors for Greenwaste Composting (Early Fall Test)

	Active Composting	Curing
NH_3 Emission Factor (lb/ton greenwaste)	1.3	0.02
VOC Emission Rate (lb/ton greenwastes)	4.75	0.3

Early Winter Source Testing
The early winter test was conducted on three piles that were approximately 2-days and 14-days old. Different aged piles were also tested to ensure representation at various stages of composting process; however, the winter test was not conducted on the curing pile. Instead, the average emission rates in lb/hr/1000 ft^2 of the 45 and 70-day piles from the early fall test were used to represent curing emissions for the early winter test.

The early winter emission rates are presented in Table 2-7 – Emission Rates (Early Winter Test).

Table 2-7
Emission Rates (Early Winter Test)

	2-day Pile	14-day Pile	45-day & 70-day Pile
NH_3 Emission Rate (lb/hr•1000 ft^2)	0.018	0.048*	0.004
VOC Emission Rate (lb/hr•1000 ft^2)	0.28	0.21*	0.079

(*) Average of two piles

The above emission rates were then used to estimate the emission factors presented in Table 2-8 – Emission Factors (Early Winter Test).

Table 2-8
Emission Factors (Early Winter Test)

	2-day Pile	14-day Pile	45-day & 70-day Pile
NH_3 Emission Factor (lb/ton greenwaste)	0.06	0.24	0.03
VOC Emission Factor (lb/ton greenwaste)	0.91	1.06	0.5

Based on previously described 22-day active phase assumption, the estimated active and curing emissions factors for greenwaste composting are presented in Table 2-9 – Emission Factors for Greenwaste Composting (Early Winter Test).

Table 2-9
Emission Factors for Greenwaste-Composting (Early Winter Test)

	Active Composting	Curing
NH_3 Emission Factor (lb/ton greenwaste)	0.3	0.02
VOC Emission Rate (lb/ton greenwaste)	1.96	0.5

In summary, greenwaste composting weighted-average emission factors presented in Table 2-10 are used to develop an emission inventory profile of the composting and related operations industry.

Table 2-10
Weighted-Average Emission Factors for Greenwaste Composting

	Active Composting	Curing
NH_3 Emission Factor (lb/ton greenwaste)	0.83	0.02
VOC Emission Rate (lb/ton greenwastes)	3.44	0.4

Based on this analysis, it was determined that for greenwaste composting, the majority of ammonia and VOC emissions are generated during active composting. These emission factors are believed to represent emissions for the current state of the industry. In general, instead of using windrow composting, with frequent turning by scarabs or wildcats, greenwaste facilities process mounded stockpiles of greenwaste without frequent turning.

Additional Greenwastes Testing
In addition to the early fall and early winter source testing conducted by the AQMD, the CIWMB and the City of Los Angeles also conducted three source tests: one at a chipping/grinding facility and two tests as greenwaste composting facilities, one of

which is using the windrow composting technique. The testing was conducted with the Emission Isolation Flux Chamber approach. The staff, at both CIWMB and City of Los Angeles, have worked cooperatively with the AQMD staff to ensure consistent emissions analysis. Although the final results have not been completely reviewed by AQMD staff in time to be included in this report, AQMD staff will incorporate those test results to the greenwaste composting emissions analysis and report the revised analysis to stakeholders as soon as possible.

Baseline Emissions

Table 2-11 – Baseline Emissions Inventory provides an emission inventory profile of the composting and related operations industry. As shown in Table 2-11, the composting and related operations industry, as a whole, generates approximately 6.8 tons per day of VOC emissions, which would place this industry as the second largest stationary source category, with the refinery industry being the highest source category.

Table 2-11
Emissions Inventory

Process	**Throughput Tons/year**	**Emissions Factors**		**Emissions (tons/year)**				**Total Emissions (tons/year)**	
				NH_3		**VOC**			
		NH_3 lbs/ton	**VOC lbs/ton**	**Active**	**Curing**	**Active**	**Curing**	**NH_3**	**VOC**
Co-Composting	922,190	2.93	1.78	677.8	677.8	654.8	166.0	1355.6	820.8
Greenwaste-Composting	832,191	0.85	3.84	345.4	8.3	1431.4	166.4	353.7	1597.8
Chipping/ Grinding	3,033,092	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Exempt Facilities	36,865	0.85	3.84	15.3	0.4	63.4	7.4	15.7	70.8
			Total	**1038.5**	**686.5**	**2149.6**	**339.8**	**1725**	**2489.4**
Totals in tons per day based on 365 days per year				**2.8**	**1.9**	**5.9**	**0.9**	**4.7**	**6.8**

Of this inventory, there are 7 co-composting and 12 greenwaste composting facilities that generate an annual VOC emissions exceeding the 10 tons per year threshold for major sources as defined in District Rule 3001. Depending on the throughput, the largest greenwaste facility is estimated to emit up to 600 tons per year of VOC, which would be considered among the top 5 VOC emitters in the SCAB.

CHAPTER III

CONTROL TECHNOLOGY ASSESSMENT

INTRODUCTION

This chapter discusses the following:

- ✓ Composting Methods;
- ✓ Emission Control System (Biofilter);
- ✓ Demonstrated Control Efficiencies; and
- ✓ Chipping and Grinding Methods.

COMPOSTING METHODS

Emissions from composting can be reduced by maintaining optimal aerobic conditions, or utilizing state-of-the art emissions control technologies, such as aeration static pile (ASP), in-vessel, and biofilters.

Optimized Practices

Maintaining optimal aerobic composting conditions can reduce some emissions and odors from composting operations. The microorganisms responsible for composting function best within a given range of parameters such as carbon to nitrogen ratio, moisture content, oxygen concentration, pH, and temperature of the compost piles. Although optimal conditions can vary based on the type of feedstock, preferred ranges are typically in the following:

Table 3-1
Optimal Composting Conditions

Characteristic	Preferred Range
Carbon:Nitrogen ratio	25:1 to 40:1
Moisture content	50% to 60%
Oxygen concentration	5% to 15%
PH	6.5 to 8.0
Temperature	130°F to 150°F

Additionally, good practices for compost mixing, curing and storage can also reduce odors, dust and emissions; however, the amount of reduction cannot be easily quantified.

Aerated Static Pile (ASP)

ASP was developed to eliminate substantial land space requirement and other problems associated with windrow composting. ASP is an established technology where forced aeration is applied to provide direct, precise control of oxygen, temperature, and moisture conditions to the pile. Currently, there are approximately 118 operational composting facilities in the U.S. utilizing the ASP technology, two of them are located in the AQMD jurisdiction. Some of the ASP facilities operate within enclosures for further control. These facilities handle a daily throughput ranging from about 0.1 dry ton to 300 dry tons. In addition, several groups in the AQMD jurisdiction also consider ASP for their facilities.

With the ASP, feedstock is piled over a base of porous materials such as wood chips, which contains perforated aeration pipes. In order to avoid short circuiting, the porous base should be smaller than the base of the pile. The perforated pipes are connected to a blower that either pulls (negative pressure or suction) or pushes (positive pressure) air through the pile. The blower should be operated intermittently to maintain the 5% to 15% oxygen range and the uniform temperature. To provide insulation and prevent escape of odors during composting, the pile is usually covered with a thick layer (12 to 18 inches) of finished compost or bulking agent.

With positive pressure aeration, contaminated air is pushed through the pile to the outer surface; therefore, is difficult to be collected for odor treatment. However, positive pressure aeration is more effective at cooling the pile because it provides better airflow.

With a suction system, air is pulled through the pile from the outer surface. Contaminated air is collected in the aeration pipes and can be directed to an odor treatment system. To avoid clogging, condensed moist air drawn from the pile must be removed before reaching the blower. Negative aeration might create uneven drying of the pile due to its airflow patterns.

A study conducted by City of Columbus, Ohio demonstrates that the weighted-average odor emissions from an outdoor negative aeration pile is approximately 67% lower than those from an outdoor positive aeration pile. However, to provide flexibility in operations, some composting facilities aerate in both positive and negative modes. Negative aeration is usually used during the beginning of the composting process to greatly reduce odors. In enclosed active composting area, negative pressure aeration also reduces moisture released into the building, and thus, reduces fogging. Positive aeration is used mostly near the end of the composting cycle for more efficient drying of the compost.

In summary, compared to traditional windrow composting, ASP provides a more precise control of oxygen and temperature conditions; therefore, it can reduce odors and emissions by promoting optimal aerobic conditions. However, currently there is no field measure available to quantify any additional emission benefit of ASP (i.e., lower pile emissions). An ASP confined in a building enclosure would capture 100% of its emissions to an emission control device that will be discussed later in this chapter. ASP also provides better flexibility to handle changes in compost feedstock quantity and quality. In addition, it requires less time to complete the active composting phase. With proper operation, active composting from an ASP might be completed within 20 to 28 days; therefore, more finished compost can be produced in a smaller footprint. Study conducted by Synagro Composting Facility indicates that, in comparison to windrows, ASP reduces the landspace requirement on the order of 60%. There are two common forms of ASP: individual piles and extended piles.

Individual Piles

Individual piles are long triangular piles that are usually constructed with a width equal to about twice the height. The aeration pipes run lengthwise beneath the ridge of each pile and serve the entire pile. Each pile contains feedstock of roughly the same recipe and age. Individual piles are practical when feedstock is available for composting at intervals.

Extended piles

To make more effective use of available space, another pile configuration called the extended aerated pile has been developed. Studies indicate that the area required for an extended pile is about 50% less than that for an individual pile. Extended piles consist of individual cells that are stacked against each other. Cells of new feedstock are constructed in one pile, and cells of nearing mature compost are placed in other. The space between the two piles allows the removal of an old cell from one pile and adding of a new cell to the other. Cells are usually constructed with a width equals to the pile's height. Each cell contains one day's volume of feedstock. Generally, each cell is aerated by its own blower and controlled by its own timer or temperature sensor. However, cells contain feedstock of roughly the same age can share a single blower by connecting the pipes with a header. Connecting several cells to one blower minimizes the number of blowers required, but also complicates the blower control system.

Appendix A contains the list of ASP composting achieved in practice, which based mainly on the 1998 Biocycle survey.

In-Vessel Composting

In-vessel is developed to eliminate substantial land space requirement for windrow composting, as well as to overcome the deficiencies in windrow. In-vessel composting is an established technology where feedstock is confined within a building, a container, or a vessel. In-vessel methods rely on forced aeration and mechanical turning to speed up the composting. Currently, there are approximately 50 operational composting facilities in the U.S. utilizing in-vessel technology; one of them is located in the District. These facilities handle a daily throughput ranging from less than 1 dry ton to over 100 dry tons. There are different types of in-vessel, such as silos, rotating drums, transportable containers, bin composting, and agitated bed, which are designed/manufactured by about 15 companies; however, bin composting, silo, and agitated bed are considered the most popular in-vessel systems used in composting operations.

Bin Composting

Bin composting is the most basic and simple in-vessel technique, where feedstock is contained in a bin with or without roof. Essentially, bin composting operates like the ASP; it includes forced aeration in the floor of the bin and requires little or no turning of the feedstock. Besides having the advantages of an ASP, bin composting can also eliminate weather problems, provide better temperature control, and reduce odors released to the atmosphere.

Silo

In composting operations, vertical silo is the most popular system where air is provided from the base through the feedstock. Contaminated air can be collected from the top of the silo and vented to an odor or emission control equipment. Feedstock is loaded at the top of the silo, and finished compost is removed from the base. Typical active composting time is 14 days, so one-fourteenth of the silo volume must be removed and replaced daily. Compost is often cured in a second aerated silo, which minimizes land space. However, this composting method may be difficult to operate due to compaction, temperature and air-flow problems, which are associated with this process.

Agitated Bed

Agitated bed is a system where controlled aeration and periodic turning are combined. With this system, feedstock is placed at the front end of a long, narrow channel (bed). As the turning machine moves forward, it mixes the organic materials and discharges it behind itself. With each turning, the machine moves the feedstock a set distance toward the end of the bed. The length of a bed and the turning frequency determine the composting period. If the machine moves the organic materials 10 feet at each turning and the bed is 100 feet long, the composting period is ten days. Suggested composting periods for agitated bed system ranges from two to three weeks.

Between turnings, aeration is provided through a set of aeration pipes, which locate in the floor of the bed. Since the organic materials along the bed are at different stages of composting, the bed is divided into different aeration zones. Each blower supplies air to one zone and is controlled by a temperature sensor or a time clock.

Agitated bed composting, in combination with the use of building enclosures, are capable of capturing 100% of the process of emission and odors. This method also provides better process controls. This type of process can produce consistent quality compost, reduce the composting time cycle, and reduce operational costs, which can help offset its high capital costs.

Attachment B contains the list of operational in-vessel composting facilities in the U.S. This list is compiled based on the 1998 Biocycle survey and the input from one major in-vessel designer firm.

EMISSION CONTROL SYSTEMS (BIOFILTER)

There are several types of emissions control systems that are capable of controlling ammonia and VOC emissions; however, this discussion is limited to biofilters, since it is the most economically feasible and most common type of control equipment in composting operations.

Biofiltration is a well-established emission and odor control technology in Europe where over two hundred biofilters were in use as of 1984 (Eitner, 1984). In the United States, biofilters have been mainly utilized for the treatment of odors as well as VOC in wastewater treatment plans. Biofilters have recently gained better acceptance by composting and other operations such as body repair shops, MRF/transfer stations, pharmaceuticals, beer breweries, etc. To date, AQMD has issued 17 Permits to Operate biofilters and is processing 15 additional applications.

Basically, biofilters use microorganisms that live in the biofilm; a thin layer of moisture surrounds the particles that make up the media, to adsorb and biologically degrade contaminated air into non-harmful substances. In particular, VOC is oxidized to carbon dioxide and water, and ammonia is degraded into nitrate without creating aggravating pollution issues.

In biofilter design, the selection of a media is a critical factor. For a biofilter to operate efficiently, a media must have a good adsorption capacity and good resistance to compaction, be able to provide a suitable environment for microorganism growth and reproduction, and have high porosity for minimal back pressure. Typically, biofilter media is made up of wood waste and small portion of compost, which would provide an air-filled porosity between 40% and 60% and a pH between 6 and 8.

In order for a biofilter to perform at its best, several parameters should also be maintained:

Moisture Content
Maintaining proper and consistent moisture content in the biofilter media is essential to support microorganisms and to remove ammonia (by dissolution). Ideally, moisture levels in the media should be kept between 40% and 60% at all times; however, a range of 30% to 65% are proven acceptable. Since the media has a tendency to dry out due to the airflow, biofilters usually have a pretreatment stage that moisturizes the contaminated air before it reaches the media. However, moisture content should be carefully monitored to avoid biofilter clogging.

Temperature
The optimum operating temperature for a biofilter is between 80 ^{o}F to 100 ^{o}F. In order to avoid damaging to microorganisms, influent gas in excess of 105 ^{o}F might require cooling prior to entering the biofilter.

Backpressure
There is no absolute number for optimal backpressure (increase in pressure above normal operating gauge pressure). Backpressure varies depending upon media type, bed depth, unit airflow, media age, and may range from less than 1 inch water column to over 10 inches water column. Backpressure will rise as biofilter media ages (if there are no leaks, shortcircuits, channels, or fissures in the media.)

Maintenance
Sophisticated monitoring protocols are helpful; however, they should not take the place of regular inspection for dry spots, leaks, cracks, fissures of the media, and the presence of odors.

In composting, biofilters are usually used in conjunction with aerated static piles or in-vessel systems. Biofilters are known for their competitive capital and low operating costs compared to conventional technologies, such as carbon filtration, chemical scrubbers, or oxidation; however, it may take up a large land space. Biofilters are also known as the best systems to remove multiple odor-causing compounds at low concentration. If properly designed and operated, biofilter would achieve an overall control efficiency of 75% for ammonia and 90% for VOC (Appendix C).

There are several types of biofilters, such as single-layer open bed, multi-layer stack bed, etc. They all have two basic components: a media, and a piping system that distributes contaminated air through the biofilter.

Single-Layer Open Bed Biofilter

Single-layer open bed biofilter is the most typical biofilter used in the composting operations. With this type of biofilter, contaminated air is introduced though a distribution system, which typically contains perforated plastic pipes, embedded in a layer of gravel. Above this layer, there is a media of approximately 4-ft thick. The typical airflow rate is in the range of 3 cfm and 5cfm per ft^2 of biofilter surface. An open bed biofilter also has a sprinkler system to keep the media moist, and a drainage system to drain excess water in the event of over watering or rain.

Single-layer open bed biofilter takes up a lot of space and often causes compaction of the media, which results in an increased head loss. Depending on the usage, biofilter media might need replacement every 2 to 3 years.

Multi-Layers Stack Biofilter

Multi-layers stack biofilter is an enclosed system that can prevent compaction of the media and also minimize the space requirement. Since multiple units can be run in parallel, the biofilter will not be shut down during media replacement. This type biofilter can also minimize the risk of channeling of the contaminated air stream.

DEMONSTRATED EMISSIONS CONTROL EFFICIENCY

Biofiltration is an emission control system that has been widely used by the composting industry in the United States. The emissions control effectiveness for biofiltration is published in numerous studies. In addition, independent emissions and odors evaluations have also been conducted by facilities employing biofiltration. Appendix C – Biofilters in Operation at Composting Facilities in the United States, provide information on inlet and outlet emission rates for the biofilters systems cited. Based on these data, AQMD estimated the destruction efficiency of biofiltration to be 75 and 90 percent for ammonia and VOC, respectively.

Table 3-2 – Composting Methods, Capture and Control Efficiencies, provides a summary of methods used in the composting and related operations industry and their respective efficiencies in terms of controlling air emissions.

Table 3-2 – Composting Methods, Capture and Control Efficiencies

Composting Method	Emissions Capture Efficiency	Control Equipment Efficiency		Over-all Control Efficiency	
		Ammonia	VOC	Ammonia	VOC
Windrow	0%	n/a	n/a	0 %	0%
ASP*	25 to 33 %	75.0%	90.0%	18.8 – 24.7%	22.5 – 45.0
In-Vessel	100%	75.0%	90.0%	75.0%	90.0%

*Additional emission reduction potential from ASP cannot be quantified at this time.

CHIPPING AND GRINDING METHODS

Chipping/grinding facilities chip and grind wood/green waste, which was mostly collected from landscaping or from cities' curbside collection programs, and stockpile the processed materials until they are transferred to other facilities for different usage such as alternative daily cover (ADC), biomass fuel, mulch, or composting feedstock. Stockpiling green waste, especially those from the curbside collection where other putrescible wastes are not normally separated, for a period of time under certain moisture and temperature, will allow the organic materials to decompose anaerobically and generate odors as well as emissions. High temperature and VOC monitoring data obtained during the AQMD site visits of the chipping/grinding facilities demonstrate that those piles were in the process of decomposing.

To prevent wood/green waste from decomposing, staff recommends that certain processed and unprocessed materials to be removed from the site within certain time limit that will be determined later in the rule development process. The explicit holding times might vary by the source of unprocessed materials and by the end usage of chipped and ground materials.

Beside VOCs, chipping and grinding operations can also be sources of PM10. PM10 results from the chipping, grinding and screening of wood/green materials. It can also result when high winds entrain materials from processed material piles. To address these issues, AQMD staff is recommending consideration of the following PM10 dust controls, which are based on the Best Available Control Measures (BACM) listed in Rule 403, Fugitive Dust:

- Cover the chipped/ground material with tarps, plastic or similar covering; or
- Install a three-sided barriers equal the height of the piles; or
- Water the piles; or
- Cease all outdoor chipping/grinding activities during high winds (greater than 25 mph) or when visible plume extends more than 100 feet from the equipment.

CHAPTER IV

EMISSION REDUCTIONS AND COST EFFECTIVENESS

INTRODUCTION

This chapter discusses the following:

- ✓ Emission Reductions; and,
- ✓ Cost-Effectiveness.

EMISSIONS REDUCTIONS

AQMD staff has evaluated three control scenarios for co-composting and three for green-waste composting. Additionally, AQMD has analyzed the impact of hauling the green and sewer sludge wastes to landfills.

Co-Composting

AQMD staff analyzed the following three control scenarios for the co-composting sector of the composting industry:

Scenario 1

- Enclosure of the active and curing phase of the process and the utilization of Aerated Static Pile (ASP) system; and,
- Venting of emissions to a control device (biofilter).

Scenario 2

- Enclosure of the active phase of the process and the utilization of ASP
- Utilization of a ASP system under negative pressure for the curing phase of the process (no enclosure); and,
- Venting of emissions to a control device (biofilter).

Scenario 3

- Utilization of a ASP system under negative pressure for the active and curing phase of the process (no enclosure); and,
- Venting of emissions to a control device (biofilter).

The following assumptions were made to analyze the previously described control scenarios for co-composting:

1. The seven largest windrow facilities with a combined throughput of 894,175 tons/yr would be subject to control;
2. The ammonia emissions factor for the active phase of the process is the same as the emission factor for the curing phase of the process: 1.47 lbs/ton mix;
3. The VOC emission factor for the active phase of composting is 1.42 lbs/ ton mix;
4. The VOC emission factor for the curing phase of composting is 0.36 lbs/ton mix;
5. The windrow method of composting is assumed to be the baseline source of emissions, having no emissions capture efficiency (0%);
6. No emission reduction benefit for resting pile emissions is assumed for an ASP;
7. The capture efficiency of negative-ASP during the active phase of the process is assumed to be 33%;

8. The capture efficiency of negative-ASP during the curing phase of the process is assumed to be 25%;
9. Enclosure is assumed to mean total enclosure and therefore, having a capture efficiency of 100%;
10. The destruction efficiency of biofiltration for ammonia emissions is assumed to be 75%; and,
11. The destruction efficiency of biofiltration for VOC emissions is assumed to be 90% percent.

The following equations where used to calculate emission reductions:

<u>Emissions (tons/yr)</u>

[Total throughput (tons/yr) X Emissions Factor (lbs/ton)]/2000 (lbs/tons),

where,

- Total throughput is the total combined throughput of 7 composting facilities using the windrow method of composting; and,

- The emissions factor is a variable dependant on the pollutant and process phase.

<u>Emission Reductions (tons/yr)</u>

[Emissions (tons/yr) X Control Efficiency %]

where,

- The emissions are a variable dependant on the pollutant and process phase; and,

- Control Efficiency is the result of the capture efficiency multiplied by the destruction efficiency of the control device. Control Efficiency is a variable dependant on the pollutant and process phase.

Table 4-1 – Co-Composting Scenarios, provides a summary of the emission reductions for each of the control scenarios analyzed for co-composting.

Table 4-1 – Co-Composting Scenarios

Scenario		Composting Method	Uncontrolled Emissions (tons/yr)		Over-all Control Efficiency %		Emission Reductions (tons/yr)		Total ER (tons/yr)
Ammonia									
	Active	**Curing**	**Active**	**Curing**	**Active**	**Curing**	**Active**	**Curing**	
1	Enclosed ASP	Enclosed ASP	654.98	654.98	75	75	491.24	491.24	982.47
2	Enclosed ASP	Negative Pressure ASP	654.98	654.98	75	19	491.24	122.81	614.05
3	Negative Pressure ASP	Negative Pressure ASP	654.98	654.98	25	19	162.11	123.23	285.34
VOC									
1	Enclosed ASP	Enclosed ASP	636.65	159.16	90	90	572.99	143.24	716.23
2	Enclosed ASP	Negative Pressure ASP	636.65	159.16	90	23	572.99	35.81	608.80
3	Negative Pressure ASP	Negative Pressure ASP	636.65	159.16	30	23	188.70	36.21	224.92

Greenwaste-Composting

AQMD staff analyzed the following three control scenarios for the greenwaste-composting sector of the composting industry:

Scenario 1

- Enclosure of the active and curing phases of the process and the utilization of an Aerated Static Pile (ASP) system;
- Venting of emissions to a control device (biofilter).

Scenario 2

- Enclosure of the active phase of the process and the utilization of an ASP system;
- No control for the curing phase of the process; and,
- Venting of the active composting emissions to a control device (biofilter).

Scenario 3

- Utilization of an ASP system under negative pressure for the active and curing phases of the process (no enclosure); and,
- Venting of emissions to a control device (biofilter).

The following assumptions were made to analyze the previously described control scenarios for greenwaste-composting:

1. The ten largest facilities are open static piles windrow type operations and combined, these facilities have a total throughput of 819,461 tons/yr;
2. The emission factor for ammonia for the active phase of the composting process is 0.83 lbs/ton greenwaste;

3. The emission factor for ammonia for the curing phase of the composting process is 0.02 lbs/ton greenwaste;
4. The VOC emission factor for the active phase of composting is 3.44 lbs/ ton greenwaste;
5. The VOC emission factor for the curing phase of composting is 0.4 lbs/ton greenwaste;
6. The static windrow piles method of composting is assumed to be the baseline source of emissions, having no emissions capture efficiency (0%);
7. The capture efficiency of negative-ASP during the active and curing phases of the process phase of the process is assumed to be 25%;
8. Enclosure is assumed to mean total enclosure and therefore, having a capture efficiency of 100%;
9. The ammonia destruction efficiency for biofiltration is assumed to be 75%;
10. The VOC destruction efficiency for biofiltration is assumed to be 90% percent: and,
11. No emission reduction benefit for resting pile emissions is assumed for an ASP.

Emission reductions were calculated using the previously listed equations. Table 4-2 – Greenwaste-Composting Scenarios, provides a summary of the emission reduction for the three scenarios evaluated for greenwaste-composting.

Table 4-2
Greenwaste Scenarios

Ammonia									
Scenario		**Composting Method**	**Uncontrolled Emissions (tons/yr)**		**Over-all Control Efficiency %**		**Emission Reductions (tons/yr)**		**Total ER (tons/yr)**
	Active	**Curing**	**Active**	**Curing**	**Active**	**Curing**	**Active**	**Curing**	
1	Enclosed ASP	Enclosed ASP	340.50	8.23	75	75	255.4	6.2	261.60
2	Enclosed ASP	No Control	340.50	8.23	75	0	255.38	0	255.38
3	Negative Pressure ASP	Negative Pressure ASP	340.50	8.23	19	19	63.97	1.54	65.51
VOC									
1	Enclosed ASP	Enclosed ASP	1,411.22	162.55	90	90	1,270.16	147.50	1,417.66
2	Enclosed ASP	No Control	1,411.22	162.55	90	0	1,270.28	0	1,270.28
3	Negative Pressure ASP	Negative Pressure ASP	1,411.22	162.55	23	23	317.13	37.29	354.42

Summary

As illustrated in both Tables 4-1 and 4-2, full enclosure of active and curing piles would generate the greatest emission reductions with open ASP providing the least reductions. However, the emission reduction potential could be higher than the data presented in Tables 4-1 and 4-2 for all three scenarios, if additional emission reduction benefits from

ASP operations can be quantified. It may also modify the incremental difference between scenarios 2 and 3.

COST-EFFECTIVENESS

Affected Facilities

The control scenarios analyzed affect composting and chipping and grinding facilities in the AQMD jurisdiction. The affected facilities mainly belong to SIC 4952 (Sewerage System) and 4953 (Refuse System). Of these affected facilities, only 17 composting facilities are required to install control equipment, and, therefore, would incur significant additional costs. Of the 17 composting facilities, ten facilities are greenwaste-only and the remaining seven are co-composting facilities. Three composting facilities (18%) are located in Los Angeles County, three facilities (18%) in Orange County, four facilities (23%) in Riverside County, and the remaining seven facilities (41%) are located in San Bernardino County.

Small Business Impacts

The AQMD defines a "small business" in Rule 102 as one which employs ten or fewer persons and which earns less than $500,000 in gross annual receipts. In addition to the AQMD's definition of a small business, the federal Small Business Administration (SBA), the federal Clean Air Act Amendments (CAAA) of 1990, and the California Department of Health Services (DHS) also provide their own definitions of a small business.

The SBA's definition of a small business uses the criterion of either gross annual receipts (ranging from $0.5 million to $17 million, depending on industry type) or number of employees (ranging from 100 to 1,500). The SBA definitions of small businesses vary by 4-digit SIC code. The industries affected by the proposed Rule 1133 mainly belong to SIC 4952 and 4953—sanitary and refuse systems (miscellaneous processes). For the facilities affected by the proposed rule, gross annual receipts of $5 million is the criterion below which a business is considered small under the federal SBA definition. The CAAA classifies a facility as a "small business stationary source" if it: (1) employs 100 or fewer employees, (2) does not emit more than ten tons per year of either VOC or NOx, and (3) is a small business as defined by SBA. The DHS definition of a small business uses an annual gross receipt criterion (ranging from $1 million to $9.5 million, depending on industry type) for non-manufacturing industries and an employment criterion of fewer than 250 employees for manufacturing industries.

Of the 17 affected composting facilities, ten have gross annual receipts and employee information reported in the 2000 Dun & Bradstreet database acquired by the AQMD. Based on the AQMD’s Rule 102 definition, only one of the ten facilities would be considered a small business. With the federal SBA’s definition, three facilities would be considered small businesses. With the CAAA’s, ten could be considered small businesses. Table 4-3 provides the range of the gross annual sales and number of employees for these facilities.

Table 4-3
Number of Facilities by Sales and Employees

Gross Annual Sales (millions $)	Number of Facilities		Number of Employees	Number of Facilities
Less than $0.5	1		5 to 9	2
≥ $0.5 and ≤ $1	1		10 to 19	0
>$1 and ≤ $2.5	3		20 to 49	6
> $2.5 and ≤ $5	2		50 and above	2
≥ $20 and ≤ $50	3		100 to 500	3

Cost Assumptions
Some of the control scenarios require active co-composting and greenwaste-only processes to be enclosed and to have forced aeration, either through an in-vessel or aerated static pile (ASP) system. Emissions from the enclosure must be vented to a biofilter or other control device that achieves a control efficiency of 75 percent reduction for ammonia and 90 percent reduction for VOC.

Compliance costs of the control scenarios were estimated based on the cost of the building enclosures, ASP, and biofilters. The cost of building enclosures was estimated based on the enclosure area (square feet) required relative to the total annual throughput of an affected facility. It should be noted that total throughput includes feedstock (sewer sludge/manure) and bulking agent. In addition, for the building enclosure, two different structural designs were assumed: concrete and fabric structures. For concrete and fabric structures, estimated costs of $50 and $30 per square feet were assumed, respectively. These estimates include building structure, air exchanges and fire protection systems, and were based on City of Redlands and the IEUA RP-1 conceptual design plan. For the enclosure of active and curing, 1.5 square feet per ton of annual throughput and for enclosure of active piles only, 0.75 square feet per ton of annual throughput was used. These estimated were based on Inland Empire Utility Agency (IEUA) RP-1 conceptual design, IKEA (IEUA) site design, and city of Davenport design plans.

The cost for ASP in the city of Columbus conceptual design and the city of Davenport’s plan was used. The annualized cost of ASP was estimated at $6.75 per ton of throughput. This estimate includes flooring, piping, and aeration equipment.

The Biofilter estimate was derived based on biofilter surface required for emissions treatment. The biofilter cost was estimated at $12 per square feet of biofilter surface. This estimate was provided by Black and Veatch Company, and includes cost components such as biofilter fans, ducks, and biofilter media.

It is assumed that the economic life of building enclosures, ASP, and biofilters is 15 years each. Operating and maintenance cost for the total enclosure was assumed to be 10 percent of the total capital cost. For the biofilters, the cost of media change every three years is included in their operating cost. The total annual throughput of the affected facilities is estimated at 1,713,636 tons, of which 894,175 tons are from co-composting and the remaining 819,461 are from greenwaste only facilities.

Compliance Costs

Table 4-4 and 4-5 present annualized cost and cost effectiveness of the three scenarios for co-composting and greenwaste-only facilities. For co-composting facilities, cost-effectiveness ranges from $21,154 to $42,515 per ton of VOC reduction. The corresponding annualized costs of scenarios one, two, and three are estimated at $27.1 and $22 million, $19.9 and $17.3 million, and $12.9 million, respectively.

The annualized cost of each scenario includes both annualized cost of capital and annual operating and maintenance costs (10 % of total annual cost). The total capital cost includes cost of building enclosure, ASP, and biofilter. The capital cost is annualized by multiplying total capital cost by a capital recovery factor (CRF) of 0.090. The CRF 0.090 is based on a 15-year period (the assumed equipment lifetime) and with a 4 percent real interest rate.

For the purpose of illustration, the total annualized cost of a typical facility with an annual throughput of 200,000 tons is estimated at $4,497,300, as shown below:

Capital Cost

Total Building Cost:	$7,500,000
Total ASP Cost:	$14,250,000
Total Biofilter Cost:	$1,920,000
Total Capital Cost:	$23,670,000

Operating Cost

O & M Cost:	0.1 x($23,670,000) = $2,367,000
Total Annualized Cost	= Total Capital Cost x CRF (0.090) + O & M Cost
	= ($23,670,000 x 0.090) + $2,367,000 = $4,497,300

For each scenario, cost-effectiveness is calculated based on both overall emission reductions and VOC emission reductions only for both concrete and fabric structure designs. The cost-effectiveness analysis uses the Discounted Cash Flow (DCF) method to compute the present value of the proposed rule's costs over a 15-year period (the assumed equipment lifetime) with a 4 percent real interest rate, which gives the present value factor of 11.118. DCF cost effectiveness can then be calculated as:

$$Cost\ Effectiveness = \frac{Capital\ Costs + \left(Annual\ O\ \&\ M\ Costs \times 11.118\right)}{Emission\ Reductions_{tons/yr} \times 15\ years}$$

Table 4-4
Co-Composting Annualized Cost and Cost-effectiveness by Scenario ($/ton)

Scenarios	**Description**	**Annualized Cost (Millions $)**		**C-E for VOC Only**		**C-E for VOC & Ammonia**	
		Concrete	Fabric	Concrete	Fabric	Concrete	Fabric
1	Enclose***** Active and Curing Piles +ASP + Biofilter	$27.1	$22	$28,052	$22,779	$11,828	$9,604
2	Enclose* Active Piles only +ASP + Biofilter	$19.9	$17.3	$24,255	$21,154	$12,076	$10,531
3	Open ASP + Biofilter		$12.9		$42,515		$18,740

*Includes Static and Tipping Piles.

As with the co-composting, three scenarios representing three different levels of control were selected to analyze the effectiveness of the proposed rule on greenwaste-only facilities.

Table 4-5 presents annualized cost and cost-effectiveness of the three scenarios for greenwaste-only facilities. Cost-effectiveness ranges from $8,929 to $24,726 per ton of VOC reduced. Cost-effectiveness ranges from $9,604 to $18,740 per ton of combined VOC and ammonia reduced. The corresponding annualized costs of scenarios one, two, and three are estimated at $24.8 and $20.1 million, $17.6 and $15.3 million, and $11.8 million, respectively. There is no building enclosure requirement for the scenario three.

Table 4-5
Greenwaste-Only Annualized Cost and Cost-effectiveness by Scenario ($/ton)

Scenarios	Description	Annualized Cost (Millions $)		C-E for VOC Only		C-E for VOC & Ammonia	
		Concrete	Fabric	Concrete	Fabric	Concrete	Fabric
1	Enclose* Active and Curing Piles +ASP + Biofilter	$24.8	$20.1	$12,988	$10,547	$10,962	$8,901
2	Enclose* Active Piles only +ASP + Biofilter no Control on Curing	$17.6	$15.3	$10,291	$8,929	$8,568	$7,434
3	Open ASP + Biofilter	$11.8		$24,726		$20,869	

*Includes Static and Tipping Piles.

Due to lack of sufficient data at this time, PM10 emission reductions and additional emission reductions from ASP technology (i.e., lower pile emissions) have not been quantified for all scenarios. As a result, it is expected that emission reductions could be larger and control process would be more cost-effective than is currently established. PM10 emissions inventory as well as emission reductions will be further evaluated.

Incremental Cost-effectiveness

H&SC Section 40920.6, requires that incremental cost effectiveness be performed whenever more than one control option is available to meet emission reduction requirements for a proposed rule or amendment relating to ozone, carbon monoxide (CO), oxides of sulfur (SO_x), oxides of nitrogen (NO_x), and their precursors. Incremental cost effectiveness is defined as the difference in costs divided by the difference in emissions between one level of control and the next more stringent control. The incremental cost-effectiveness analysis related to the VOC portion of the proposed rule will be presented in the final staff report.

Unquantified Savings

Some control scenarios require active composting process to be enclosed and to have forced aeration either through an in-vessel or aerated static pile (ASP) system. This process provides a more precise control of oxygen and temperature conditions, and can greatly reduce odors and emissions by promoting optimal aerobic conditions. Furthermore, this process requires fewer spaces for active composting and reduces time required to produce final composting product. For example, the Los Angeles County Sanitation District (LACSD) composting study shows that with the ASP technology the actual surface area required for composting could be up to 60 percent less than the footprint required for active windrow composting piles. Therefore, ASP facilities sited could reduce capital investments in land acquisition.

In addition, with proper operation, active composting from an enclosed ASP could be completed in far fewer days than the 45 to 60 days under traditional windrow composting. Therefore, the volume of finished compost product and revenue generated from selling them could possibly increase. To the extent it could occur, an enclosed ASP system could reduce even more emissions generated from this additional throughput. Since the capital cost of enclosed ASP systems would remain relatively constant during the process, more throughputs would make this process more cost-effective.

Hauling Scenarios

Staff has developed two additional scenarios to further evaluate the potential cost impact, which could incur as a result of the proposed rule. Scenario one assumes that the proposed rule would cause complete shutdown of all composting facilities in the district, and, as a result, one hundred percent of the biosolid and greenwaste materials are hauled away and dumped out of the state. This estimate was based on hauling 1,713,636 tons per year of materials to landfills out of state. This estimate includes both transportation cost and tipping fees cost. Based on both LA County Sanitation District and the AQMD's survey, hauling cost is estimated at $18 per ton. This estimate includes fuel cost, driver's salary, benefits, food and depreciation of the vehicle. The tipping fees for outside of the state is assumed to be $20 per ton. Based on these assumptions, the total annual cost of hauling scenario is estimated at $38 per ton. The annual cost of this scenario is estimated at $65.1 million.

Scenario two is similar to scenario one, but assumes that only 75 percent of the biosolids and greenwaste materials would be shipped out of the state and the remaining 25 percent would be hauled to the local landfills. The annual cost includes both transportation cost and tipping fees cost. Based on the Integrated Waste Management Board (IWMB) survey data (1995-2000), the average tipping fee at the local landfill is estimated at $35 per ton. The annual cost of this scenario is estimated at $67.5 million.

According to the recent information received by staff, the projected cost of hauling waste is estimated at $63 per ton, which includes $33 per ton for transporting materials to out of state (Arizona) and $30 per ton for tipping fees charged by the landfills located outside of California. This could significantly increase the cost of the hauling scenarios described above.

In response to stakeholders questions, AQMD staff also analyzed the transportation emissions impact from increased hauling. The [potential emissions increase from hauling scenario is estimated at 13 ton of VOC, 57 tons of CO, 290.5 tons of Nox, and 7.50 tons of PM10 (Diesel) per year. These emissions are estimated based on the ARB's EMFAC 2001 emission factors from the above pollutants. The remaining assumptions are as follows:

Total Throughput per year	1,713,636
Load per Truck	23 tons
Round trip Miles	400
Number of truck Trip per year	74,506
Total number of Miles per day	81,650
Total Number of Miles per day (District)	40,825 (Based on GIS Analysis)

Affordability Analysis

For the purpose of evaluating of the financial impacts, staff has estimated the annualized cost per ton of throughput of the most likely control scenario, Scenario 2, for selected number of affected facilities. Furthermore, due to lack of financial information from these facilities, revenues from tipping fees and product sales were estimated and used as a surrogate to a facility's total revenue.

Table 4-6 and 4-7 present both annual compliance costs and revenues per ton of throughput for the selected co-composting and greenwaste-only facilities.

Table 4-6
Potential Cost Impacts of the Proposed Rule (Scenario 2) on Selected Co-Composting Facilities

Facility	Annual Throughput	Status	Annualized Control Costs	Incremental Costs Per ton of Throughput	Surrogate Revenue From Tipping Fees and Product Sales per Year ($/ton)**
A	365,000	Private	$8,134,755	$22	$18,213,500 ($40 and $30)
B	200,500	Private	$4,468,343	$22	$10,004,501 ($40 and $30)
C	250,000	Public/ Private	$5,571,750	$22	$7,475,000 ($20 and $30)

**It was assumed that only 33% of co-composting materials would be converted to a final composting product.

Table 4-7
Potential Cost Impacts of the Proposed Rule (Scenario 2) on Selected Greenwaste-only Facilities

Facility	Annual Throughput	Status	Annualized Control Cost	Incremental Costs Per ton of Throughput	Surrogate Revenue From Tipping Fees and Product Sales per Year ($/ton)**
A	312,000	Private	$6,717,017	$22	$13,728,000 ($20 and $30)
B	187,200	Private	$4,030,210	$22	$7,675,200 ($25 and $20)
C	130,000	Private	$2,798,757	$22	$3,640,000 ($12 and $20)

** It was assumed that only 80% of greenwaste-only materials would be converted to a final composting product.

The annualized compliance costs of Scenario 2 is about 50 percent of the annual revenue received by both co-composting and greenwaste-only facilities.

Financial Incentives

The facilities affected by Proposed Rule 1133 may seek funding to help defray the cost of the proposed rule. For example, the California IWMB offers funding opportunities authorized by legislation to assist public and private entities in the safe and effective management of the waste stream. The Recycling Market Development Zone Revolving Loan Program (RMDZ) provides direct loans to businesses that use post-consumer or secondary waste materials to manufacture new products or that undertake projects to reduce the waste resulting from the manufacture of a product.

Since 1998, the RMDZ program has provided financing totaling $2,146,875 (less than 10 percent of the total funding) to five companies involved in composting and $682,000 to one company involved in mulching. The RMDZ loan program is driven by increased diversion from landfills and a development of markets for recycled or recycled content products.

In addition to the RMDZ program, there are other potential sources of financial assistance for affected facilities as follows:

- Air Resources Board: Grant or loan programs regarding air quality
- California Communities: Solid Waste/Recycling–Land, Building, and Equipment Loans
- State Treasurers Office: Various bond financing and loan guarantee programs
- California Technology, Trade and Commerce: Programs for small businesses
- U.S. Small Business Administration: Various loans guarantee programs
- AQMD Small Business Assistance: Various loans guarantee programs

CHAPTER V

RECOMMENDATIONS

INTRODUCTION

This chapter discusses the following:

- ✓ AQMD staff Recommendations

AQMD STAFF RECOMMENDATION

Based on information from this report, AQMD staff is recommending that AQMP Control Measure WST-2 – Emission Reductions from Composting and Related Operations, be implemented in two phases. The first phase would consist of an adoption of a fact-finding rule that would have the elements listed below. The first phase would also include control requirements for new co-composting facilities with total design capacity of 100,000 tons per year. The second phase would consider composting control technologies for new and existing facilities based on the results of additional technical work described below. AQMD staff proposes to bring the first phase rule to the Board for consideration in mid-year 2002.

Co-Composting

As described in this report, co-composting facilities are major sources of VOC and ammonia emissions (e.g., a 100,000 ton/year total throughput facility has annual emissions of 89 tons/year VOC and 147 tons/year ammonia). Based on local community concerns and industry studies, siting of large co-composing facilities in urban areas now requires active consideration of enclosed and controlled facilities to address public health and nuisance concerns. Enclosed ASP or in-vessel systems with control equipment, while feasible and effective at significantly reducing emissions, are costly. Based on industry comment and the staff's analysis, there may be additional emission reductions associated with ASP systems that have not been quantified in this report (e.g., reduced pile emissions due to forced aeration). Additional testing of ASP systems, such as that proposed by Southern California Association of POTWS (SCAP), would allow the emission reduction potential of all control scenarios to be refined. Also, additional operational and cost information for an enclosed ASP system will be available subsequent to the opening of IEUA's'RP-1 facility in 2003. This information would allow this report's conservative cost-effectiveness analysis to be refined. PR 1133 would require that new co-composting facilities above 100,000 tons/year total throughput meet the Scenario 2 control requirements (i.e., enclosed active composting with controls) and all existing operations and new operations under 100,000 tons/year of total throughput would meet certain registration and annual reporting requirements. Specifically:

- Scenario II control requirements for new facilities with total throughput designed capacity of 100,000 tons per year;
  - ✓ Enclosure and ASP for the active phase of the process with emissions vented to a bio-filtration system;
  - ✓ Open ASP for the curing phase of the process with emission vented to a bio-filtration system;
- One-time registration with AQMD;
- Annual reporting requirements; and,

- Compliance with all applicable AQMD rules, regulations and permit conditions.

This proposal is consistent with Best Available Control Technology practices and is designed to address potential public nuisance and emission issues. AQMD staff is aware that three out of four existing facilities with designed capacities of 100,000 tons per year or more, are planning to close operations at their existing sites and move to other locations where they are expected to meet or exceed Scenario II control requirements. Furthermore, it is recommended that the AQMD staff take the following actions:

- Establish a Composting Technical Advisory Group (CTAC):

AQMD staff will continue to evaluate all source testing and other studies currently under development including, but not limited to, the SCAP study and testing conducted by the Integrated Waste Management Board. As part of this evaluation process, AQMD staff is recommending that a Composting Technical Advisory Committee (CTAC) be formed to address the technical concerns of this sector of the composting and related operations industry. The TAC would include members of the regulated community, staff from the Integrated Waste Management Board and AQMD, representatives from sanitation district and utility agencies.

- Report to the AQMD Stationary Source Committee in six months on findings from the SCAP study. The SCAP study is designed to test the effectiveness of an open ASP system and some select operating parameters and is expected to be completed by June 2002. Staff will summarize the technical findings and provide recommendations as appropriate in seeking cost-effective control opportunities.

- Provide technical assistance to local or state jurisdiction on air quality issues during permitting or the preparation of CEQA documents. During this rulemaking, the staff has obtained a great deal of information on composting air emissions and it would be beneficial to the permitting or lead agency to give adequate air quality consideration in its decision-making. It also provides an opportunity to evaluate emission reduction potential on a case-by-case basis.

Greenwaste Composting

As described in Chapters 2 and 4 of this report, the greenwastes industry represents a significant source of VOC emissions and its control options in general are considered cost-effective even without taking accounting for additional reduction potential from an ASP system. However, the affordability analysis and potential increase in tipping fees indicate that these controls are infeasible at this time without government grants to help finance controls. As a result, the staff is proposing minimal requirements on the industry at this time and the proposed requirements would primarily track its operations and emissions inventory and to claim SIP reductions should site-specific controls be implemented. The following summarizes the proposed requirements:

- One-time registration
- Annual reporting requirements
- Compliance with all applicable AQMD rules, regulations and permit conditions

In light of the fact that there are cost-effective control options for this industry that are not yet affordable, AQMD staff is recommending that, through the District's Legislative Committee, special funding from the state legislature be sought to implement state of the art composting methods, including but not limited to, enclosed ASP. AQMD staff will work with the CIWMB and CARB to seek additional funding and/or make existing funding directed more towards air quality spending.

Chipping and Grinding Requirements

- One-time registration;
- Compliance with all applicable AQMD rules, regulations and permit conditions;
- Holding time restrictions by source of unprocessed materials and by the end usage of chipped and ground materials; and
- PM10 controls to prevent visible PM10 emissions over the property line during operations and from processed material piles.

Exemptions

- Portable chipping and grinding
- Community composting
- Agricultural composting
- Nurseries
- Small Operations (throughput threshold to be determined)

Registration and Annual Reporting Requirements

The one time registration requirement will, at a minimum, require facility owners and/or operators to provide the following information:

- ✓ Facility name;
- ✓ Facility location and mailing address;
- ✓ Facility legal owner;
- ✓ Facility operator;
- ✓ Facility contact person;
- ✓ Facility IWMB identification number and contact person;
- ✓ LEA identification number and contact person;
- ✓ Facility designed capacity (throughput);
- ✓ Feedstock description;
- ✓ Composting process description;
- ✓ Products produced;
- ✓ Customers profile;
- ✓ Tipping fee schedule; and,
- ✓ Number of employees.

The annual reporting requirements would require the following information:

- ✓ Update of registration information, as pertinent;
- ✓ Annual actual throughput;
- ✓ Number of enforcement actions against the facility by enforcing agency;

Annual Status Report

The information received from the co-composting and greenwaste facilities and their emission estimates will be summarized and presented as an annual status report to the AQMD Stationary Source Committee. As part of this report, funding opportunities, composting technology, progresses in emission reductions will also be included.

CHAPTER VI

PUBLIC OUTREACH

INTRODUCTION

This chapter discusses the following:
- ✓ Public Outreach

PUBLIC OUTREACH

The public outreach efforts for Proposed Rule 1133 – Composting and Related Operations, included public meetings, focused presentations, and site visits. The meetings were well attended. In general, the average number of people in attendance for each of the meetings range from 60 to 80 people. Following is chronological listing of the public meetings.

- ♦ Public Consultation Meeting, October 5, 2000
- ♦ Proposed Rule 1133 Working Group Meeting, August 22, 2001
- ♦ Public Workshop, September 5, 2001
- ♦ Proposed Rule 1133 Working Group Meeting, September 28, 2001
- ♦ Proposed Rule 1133 Working Group Meeting, January 15, 2002
- ♦ Proposed Rule 1133 Working Group Meeting, February 19, 2002

Focused presentation on Proposed Rule 1133 where given to the following entities:

- ♦ Orange County League of Cities
- ♦ San Gabriel Valley COG Solid Waste Committee
- ♦ California League of Cities – Environmental Quality Committee
  - ✓ Membership includes all cities in the State of California
- ♦ San Bernardino County Solid Waste Advisory Task Force
- ♦ California Contract Cities Association, Legislative Committee
- ♦ SCAG Solid Waste Task Force
- ♦ Los Angeles County Solid Waste Management Committee Integrated Waste Management Task Force
- ♦ AQMD's Ethnic Community Advisory Group

- AQMD’s Local Governments and Small Business Advisory roup

- AQMD’s Stationary Source Committee

AQMD staff conducted site visits to the following facilities:

- Aguinaga Fertilizer
- B. P. Hauling
- California Biomass
- Community Recycling & Resource Recovery, Inc.
- Empire Utilities Agency Composting Facility
- Inland Empire Composting
- Leisure World
- Los Angeles City – Archrorage
- Los Angeles City – Griffith Park
- Los Angles City – VanNorman
- R & S Dumping Service
- Rancho Las Virgenes Composting Facility
- River Ranch Recycling Organics
- Salado Creek – Coachella Landfill Composting
- Sierra Soil Company
- Synagro
- Tierra Verde Industries
- Whittier Fertilizer

In addition to the site visits, AQMD staff has met numerous times with industry and sanitation district(s) representatives, individually and in groups, to address specific rule proposal issues and discuss research plans.

Following is a list of all the cities and governmental agencies that to date have been active in the rulemaking process for Proposed Rule 1133:

- City of Burbank

- City of Cerritos

- City of Chino

- City of Chino Hills

- City of Colton

- City of El Segundo

- City of Glendale
- City of La Canada-Flintridge
- City of Los Angeles
- City of Newport Beach
- City of Palm Springs
- City of Pasadena
- City of Pico Rivera
- City of Redlands
- City of San Diego
- City of San Marino
- City of Santa Fe Springs
- City of Upland
- City of West Covina
- City of Whittier
- Eastern Municipal Water District
- Inland Empire Utilities Agency
- Las Virgenes Municipal Water District
- Los Angeles City Dept. of Water & Power
- Los Angeles County – Dept. of Parks & Recreation
- Los Angeles County – Public Works Dept.
- Los Angeles County Arboretum & Botanical Gardens
- Los Angeles County DPW
- Los Angeles County LEA
- Los Angeles County Sanitation District
- Municipal Water District
- Orange County Council of Governments
- Orange County Integrated Waste Management
- Orange County Sanitation District
- Riverside County Environmental Health
- Riverside County Waste Management Dept.

- San Bernadino County LEA
- San Bernadino County Solid Waste Management District
- Southern California Alliance of Publicly Owned Treatment Works
- Southern California Association of Governments
- Ventura County Air Pollution Control District
- Ventura County LEA
- Western Riverside Council of Governments

REFERENCES

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