Bay Area Air Quality Management District
939 Ellis Street
San Francisco, CA 94109

Proposed Revision of Regulation 8, Rule 8: Wastewater Collection Systems

Staff Report

March 17, 2004

Prepared by:

Damian Breen
Compliance and Enforcement Division
Air Quality Specialist II

Reviewed by:

Dan Belik
Rule Development Manager

Kelly Wee
Director of Compliance & Enforcement

Table of Contents

I. EXECUTIVE SUMMARY

The Bay Area 2001 Ozone Attainment Plan contained a commitment (Further Study Measure 9) to examine wastewater collection and treatment systems at refineries, for potential volatile organic compound (VOC) emission reductions. Due to the size of these systems, many spanning hundreds of acres, a technical assessment document (TAD) was first prepared for the collection portion of these systems. The collection system consists of drains from process units piped to mechanical separation such as oil/water separators. As a result of the findings in the TAD, prepared jointly with the California Air Resources Board (CARB), the Bay Area Air Quality Management District (the District) was moved to a control measure.

Throughout this process the District staged numerous technical working group meetings that included industry, environmentalists and the Regional Water Quality Control Board. The development of the current emissions estimate was greatly dependant on the co-operation staff received from the refineries. This collaborative technical process has been highly successful and is presently continuing in an effort to assess emissions from the refinery wastewater treatment systems.

VOC emissions from wastewater collection systems are generated when organic liquids are entrained in waters used in refinery processes. These partial petroleum products are volatilized during transport to an onsite wastewater treatment system by exposure to high temperatures and turbulence in the transport structures (pipes, manholes, junction boxes, sumps and lift stations). The emitted vapors collect in the headspaces of these transport structures and are passively vented to the atmosphere through uncontrolled system openings.

Currently, the only District control on wastewater emissions is Regulation 8, Rule 8. This limits organic emissions from oil/water separators and dissolved air flotation units at refinery, chemical and other plants throughout the Bay Area. It also limits emissions from sludge dewatering and slop oil vessels.

The proposed amendments to Regulation 8, Rule 8 would result in a reduction of VOC emissions of at least 1.9 tons per day, including the reduction of toxic compounds such as benzene, toluene and xylene.

The major proposed amendments to Regulation 8-8 include:

- A 500ppm leak standard measured with an Organic Vapor Analyzer (OVA) for all wastewater collection components.
- Control equipment mandate for leaking components
- An inspection and maintenance program for wastewater components under the regulation.

It is estimated that the cost-effectiveness to reduce emissions from drains, manholes, and junction box vents ranges from $1900 to $4200 per ton of VOC reduced. This is within the range of cost-effectiveness determined for other VOC control measures adopted by the District.

II. BACKGROUND

A. Process Description

In the Bay Area 2001 Ozone Attainment Plan for the San Francisco Area air basin, the District committed to examine potential VOC emissions reductions from further control of refinery wastewater collection and treatment systems. In order to achieve this goal, staff of the California Air Resources Board (CARB) led a joint effort to quantify these emissions and suggest possible controls.

Refinery wastewater systems exist to separate and process organics entrained in water during the making of petroleum products. Water has many uses in the refining process, including crude oil washing, process unit cooling, component cooling, steam production and vessel and tank cleaning. During these and other processes, volatile organic compounds (VOC's) become entrained in the water due to direct contact. Other sources of wastewater at the refinery include water condensate drawn off refinery tanks and ground water extraction wells.

The five Bay Area refineries each have unique wastewater systems, however, each of these systems have common components. In the refinery, process block drains provide the entryway for water containing organics into the wastewater collections system. These drains feed a network of pipes that transport the wastewater in a segregated system to an onsite treatment facility. Along this piping network there are a series of manholes and junction boxes. Manholes allow access to the piping network to clear line blockages and perform maintenance, and junction boxes allow separate effluent steams to be combined. In addition to these structures, refinery wastewater collection systems may contain pumping or "lift" stations and low point or gravity sumps.

All of the wastewater gathered by the collection systems at each refinery is routed to wastewater treatment. The first system in refinery wastewater treatment is oil/water separation. Wastewater flow is introduced to a quiescent environment where heavy organics and particulates settle out under gravity and lighter oils and organics float to the surface to be removed to slop tanks by mechanical skimmers. Following oil/water separation, wastewater is routed to dissolved nitrogen or dissolved air flotation units. Here gas is percolated through the wastewater to float organics to the tank surface where it is removed to slop tanks. Both oil/water separation and dissolved gas flotation are enclosed as required by Regulation 8, Rule 8.

It is at this stage the wastewater again comes in contact with the ambient air. This usually occurs at the biological treatment unit. There are a host of other steps in many of the refinery wastewater treatment trains. These steps include flow equalization, pH balancing, chemical and nutrient addition are all designed to protect the living organisms in the biological treatment unit. These organisms feed on the organic content of the wastewater and are designed to clean the water until it complies with Regional Water Quality Control Board (RWQCB) discharge standards.

Refineries may also employ additional polishing steps in their treatment processes, such as the addition of activated carbon to their biological treatment units, selenium treatment, wetlands and carbon filtration. These steps ensure that the water discharged into the bay meets all applicable standards.

Refinery collection, separation and treatment systems can span hundreds of acres. Quantifying emissions from the various collection and treatment components can be difficult. There is little available direct measurement data on some parts of the system and sophisticated models developed by EPA and industry are not adequate for many of these system aspects. As a result, it was decided that the best way to approach the task of quantifying and controlling emissions was to break the refinery wastewater system into sections. Analysis of the systems showed that a partition could be made after physical separation (following the oil/water separators and dissolved air or gas flotation). The following two divisions were made:

Collection and Separation: This is the portion of the system that collects wastewater from process units and tankage, and performs physical separation of oil from water. Effluent is then directed via a series of wastewater collection components (process drains, pipes, manholes, junction boxes, sumps and lift stations) to the oil/water separator for initial treatment. The oil/water separator slows the water flow down and allows the settling and flotation of light and heavy hydrocarbons out of the waste stream. These hydrocarbons are removed by skimming to slop oil tanks. The effluent then goes through dissolved air flotation units (DAF) or dissolved nitrogen flotation units (DNF). Here gas is bubbled through effluent to remove any residual gross oil or particulates not removed in the oil/water separator.

Treatment: This is the portion of the system after physical separation deals with the treatment of wastewater to remove entrained or dissolved organic compounds. The components in this portion of the system may include:

activated carbon injection tanks, flocculation tanks, biofilters, filters, screens, clarifiers, sludge thickeners, bioreactors, sludge presses, selenium removal and carbon filtration.

The Technical Assessment Document prepared by District and CARB staff deals exclusively with emissions from the collection portion of the wastewater system. The majority of emissions from this portion of the system are generated in the following two ways:

Volatilization : This occurs when wastewater that contains petroleum or partially processed petroleum products is exposed to the atmosphere. When this happens, compounds biodegrade and volatize from the water into the air. The factors that effect this process are temperature, concentration, the gas/liquid partition coefficient, biodegradability, the affinity for adsorption, ventilation of the system and turbulence or splashing.

Air Entrainment: When liquid that contains petroleum or partial petroleum products is transmitted in contact with air to a transportation system (from a process outlet into a drain) ambient air is entrained in the liquid. Air pockets may become trapped below the water surface and will return to the surface to off-gas later. This off-gassing will include the release of captured VOC's.

The TAD for the refinery wastewater collection systems quantified, through field sampling and emissions modeling, a VOC emissions estimate of at least three tons per day. The decision on the most appropriate methodology to assess these emissions was greatly assisted by a technical working group that included industry, environmentalists and the Regional Water Quality Control Board. In addition to this group, the industry provided access to their facilities and staff, and helped shoulder the technical burden of the TAD by both providing resources and consultants (Brown and Caldwell) to assist staff in the development of the best available emissions estimate. A similar process is already underway to assess emissions from refinery wastewater treatment systems.

Several technologies are available to control these emissions. They can be largely grouped into two categories, pollution prevention and emissions controls. Pollution prevention strategies can reduce emissions at their source by changes in operation, while emission controls are designed to reduce emissions after VOC containing materials have entered the wastewater system. Examples of emissions controls are gasketed or sealed collection system components, water sealed collection system components, activated carbon scrubbers, water impingement scrubbers, vacuum stripping columns and thermal oxidizers.

B. Regulation 8, Rule 8: Wastewater (oil-water) Separators

Regulation 8, Rule 8 was first adopted by the District on January 17, 1979, amended March 17, 1982, October 8, 1989, and last amended on June 15, 1994. The regulation requires controls on small wastewater separators and junction boxes, enclosure of sludge dewatering facilities, and required the retrofit of larger refinery wastewater oil-water separators. The amendments in 1994 corrected EPA policy deficiencies.

Reg. 8-8 inspections at refineries are conducted unannounced to the facility. The responsible inspector will visit the regulated oil/water separator and ensure that all accesses to it are sealed and gasketed. If the oil/water separator tank area is enclosed and the flow through the system exceeds 18.9 liters per second, then no sealed gasket shall exceed an emission standard of 1,000 ppm (methane) measured at the affected component. The inspector will also check any floating roof-seals which may be present for the correct spacing and will also check to see that all oil/water sludge dewatering operations are completely enclosed and under vapor controls.

C. Applicable Federal Regulations

Two federal regulations also may affect refinery wastewater systems. They are NSPS (New Source Performance Standards) for VOC Emissions from Petroleum Wastewater Systems (Subpart QQQ) and NESHAP (National Emission Standards for Hazardous Air Pollutants) for Benzene Waste Operations (Subpart FF). Both regulations pertain to the emissions of VOCs and toxic compounds from refinery wastewater systems.

Under Title 40 CFR Part 60, Subpart QQQ, performance standards have been established for individual drain systems, including:

- Each drain shall be equipped with a water seal
- Junction boxes shall be equipped with a cover and may have an open vent
- Sewer lines shall not be open to the atmosphere
- Regular inspection and maintenance requirements.

Also under Title 40 CFR Part 60, Subpart QQQ, performance standards have been established for closed vent systems and control devices, including:

- Any control device shall operate with an efficiency of 95 percent or greater to reduce VOC emissions vented to them
- All control devices shall be operated with no detectable emissions, as indicated by an instrument reading of 500 parts per million VOC above background.

<u>The National Emission Standards for Hazardous Air Pollutants (NESHAP)</u> for refineries were promulgated in August 1995. These regulations are applicable at refineries that emit 10 tons per year (tpy) of any one hazardous air pollutant

(HAP), or 25 tons per year or more of total HAPs. The refineries in the District meet this threshold requirement and are subject to the refinery NESHAP requirements.

Under Title 40, CFR, Part 61, Subpart FF, the benzene NESHAP regulations require, among other things, that petroleum refineries use maximum achievable control technology (MACT) to control emissions of benzene from waste operations, including certain wastewater systems. Typically, refineries use carbon absorption or collection and venting of wastewater gases to the refinery flare system (vent flap system) to control benzene emissions from wastewater systems in compliance with the refinery NESHAP requirements.

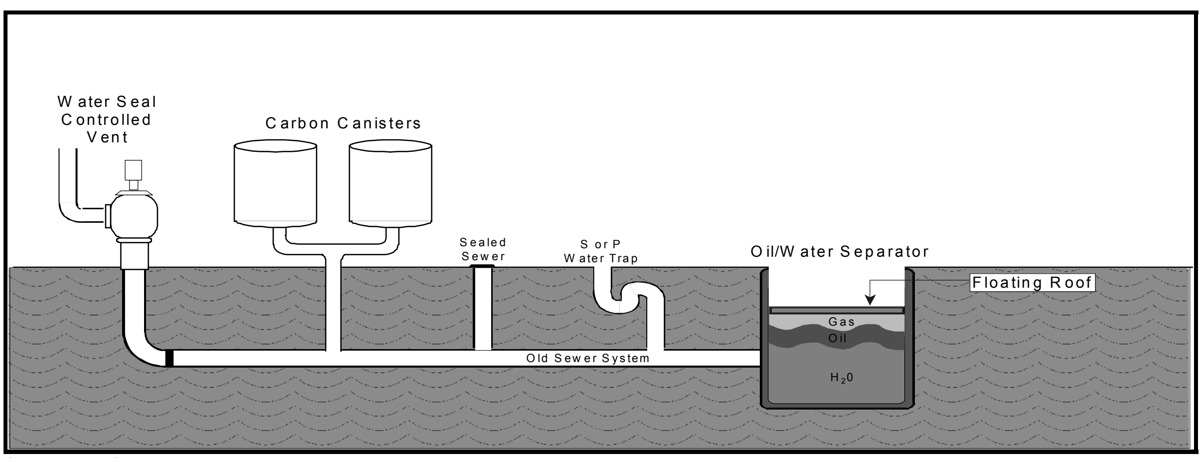
District inspectors enforce the provisions of federal NESHAP (National Emission Standards for Hazardous Air Pollutants) Subpart FF for Benzene Waste Operations. This entails conducting visual checks of controlled water trap drains in affected units.

III. APPLICABLE CONTROL TECHNOLOGY

VOC emissions from wastewater collection systems can be controlled in a variety of ways including enclosing or controlling all openings to the atmosphere, changing the operation of the units that are feeding the wastewater collection system, having a rigid inspection and maintenance (I&M) program or using a combination of controls.

Equipment control strategies can require the installation of new equipment or devices, or can include physical changes to the wastewater system. Potential equipment control strategies applicable for refinery wastewater systems can include a number of different components. Figure 1 schematically shows the application of these control strategies in a wastewater system.

Figure 1: Potential Equipment Control Strategies



Source: U.S. EPA

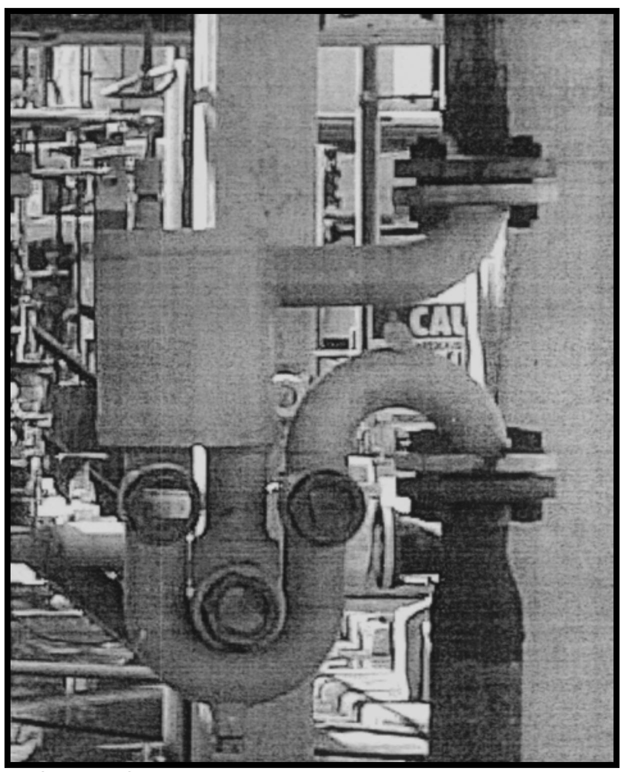
Water Seals

Installing water seals on process drains and vents open to the atmosphere would help prevent emissions from downstream sewer lines from escaping back out of the drain or vent opening. However, even with water seals installed in drains, emissions have been reported from VOC-containing liquid left standing in the water seal that was not flushed into the sewer line. In addition, if the water were allowed to evaporate from the water seal control, the emissions from the drain or vent would be similar to those from uncontrolled units. Below are two types of water seal configurations:

- P-leg seal configuration (similar to a kitchen sink drain).
- Liquid seal inserts that can be placed in existing process drains and junction box vents (Figure 2).

The overall control efficiency of this method is estimated at 65%, but varies depending on the degree of maintenance of the water seal.

Figure 2: Typical Design of a Liquid Seal Insert For Junction Box Vents



Source: Chevron

Control measures such as water seals require an extensive inspection and maintenance (I&M) program in order to be effective. I&M programs are also useful and necessary tools to ensure that the emission reductions achieved through the use of equipment controls are realized. An effective I&M program is designed to inspect (on a regular basis), maintain and repair (as necessary) the pertinent components of a pollution control system for proper operation. These inspections are usually performed by refinery personnel and could include:

- Inspection of sealed manholes for corrosion and leaks
- Inspection of water seals for evaporated water or accumulation of trapped VOC containing material
- Inspection and repair of visible leaks from a sealed wastewater system
- Measurement of VOC concentrations in and around controlled systems (leak detection program)

Vent Control Devices

Collecting and venting the emissions to a control device can achieve a control efficiency of greater than 95%. Potential emission control devices for wastewater collection systems (predominately junction box vents) include:

- carbon adsorption
- thermal oxidation
- catalytic oxidation
- condensation

Hard Piping

Enclosing open weirs and lines with direct piping (also called hard piping) is the most stringent control option and could result in the greatest amounts of VOC emission reductions. Complete drainage system enclosure can be accomplished in the following manner:

- Hard-pipe process units to the wastewater separator and then remove or cap all existing process drains.
- Hard-pipe process units to a drain box enclosure.
- Hard-pipe those process units identified as the largest contributors to process drain emissions.
- Hard-pipe junction boxes that are completely covered and sealed with no openings.

This method is considered to have up to 100% control efficiency[1]. However, the safety issues and reconstruction complexity may be two prohibiting factors that reduce the likelihood of converting an existing open drainage system to a totally enclosed system.

Emissions or Performance Based Standards

An emissions or performance based standard would set a limit on the emissions

[1] “Final Staff Report for Proposed Rule 1176 – VOC Emissions from Wastewater Systems”, South Coast Air Quality Management District, September 13, 1996.

from specific emission points in a wastewater system. Such a limit might consist of the amount of organic compounds that could be emitted in pounds per day or a limit on the concentration of emissions in parts per million (ppm).

Setting performance based standards allows a wastewater system operator to consider the optimal type(s) of control strategies that meet a particular need based upon system design and emission levels from each wastewater component. By establishing performance-based standards, such as setting an emission limit of 500-ppm VOC from a drain or vent, equivalent emission reduction can be achieved without specifying a particular control technology.

Pollution Prevention Strategies

In addition to the use of equipment control strategies to reduce VOC emissions from wastewater collection systems, there are also several control strategies that could be implemented to reduce emissions from these systems. This approach differs from the equipment control strategies in that it is designed to reduce the source of the VOC emissions (pollution prevention) through operational changes in the refinery, as opposed to controlling the emissions themselves with equipment. Additional measures, such as the use of I&M programs, can further serve to reduce emissions from wastewater collection systems.

For refinery wastewater collection systems, the following pollution prevention control measures have been identified as potential control measures to reduce VOC emissions :

- Reduce the generation of tank bottoms (these are the residues left in tanks containing petroleum products prior to cleaning)
- Minimize solids leaving desalter units to prevent organic from entering the wastewater collection system (a desalter unit removes mineral salts from crude oil using a water washing technique)
- Minimize and/or segregate cooling tower condensate from wastewater collection
- Minimize fluid catalytic cracking unit decant oil sludge (this sludge oil is the residue produced during the clean up following the catalytic cracking process)
- Control heat exchanger cleaning solids and sludge
- Minimize discharge of surfactants into wastewater collection system
- Thermally treat petroleum sludges to prevent the evaporation of organic vapors
- Reduce use of open pits, tanks, and ponds
- Remove unnecessary storage tanks from service
- Segregate storm, process, and septic wastewater collection

- Improve recovery of petroleum products from wastewater collection systems
- Identify VOC sources and install upstream water treatment and/or

separation

- Use oily sludges as feedstock (feedstock is the material used as the raw material of “feed” in various petroleum production processes)
- Control and reuse fluids from coking units and coke fines. Coke fines are the granular carbon particulates produced by the coking process
- Train personnel to reduce solids disposal to sewers

An I&M program, in addition to that discussed for equipment controls, can be designed to ensure that pollution prevention programs, such as reduced waste generation and solids control, are being followed. These types of procedures could include monitoring of waste generation, either through continuous samplers or regular testing, monitoring the use of open pits and ponds, and regular training of refinery inspectors.

IV. REGULATORY PROPOSAL

In analyzing the best method for achieving the maximum emissions reduction from these systems allowing for the greatest flexibility for the affected facilities, staff recommend a combination of emissions controls, a performance based standard (500 ppm) and a mandated I&M program.

The use of one or more of these techniques can result in the reduction of emissions from the wastewater transportation system. Currently, the only District standard that deals with wastewater is Regulation 8-8. This standard mandates gasket-sealed covers for both oil/water separators and DAF units.

To get the emissions reductions desired, Reg. 8-8 will be modified to include a strict concentration limit, an inspection and maintenance program and an equipment control standard for refinery wastewater collection systems.

Based on the Districts review of the available materials, a 500 ppm standard for drains, manholes, junction boxes, trenches, reaches, sumps, lift stations and oil/water separators has been determined to be the best concentration limit standard currently achievable by the industry. While the wastewater collection systems are not designed to the standards of other refinery product transportation systems, this standard is thought to be achievable due to lack of high pressures and temperatures in these systems.

This conclusion has also been supported by limited sampling by the District staff, consultations with the South Coast AQMD staff and information supplied through the workgroup process by the refineries. During discussions with the South Coast staff the derivation of the 500 ppm standard contained in the comparable South Coast Rule was reviewed. This standard is based on the Federal Regulation for Benzene waste (40 CFR 61 subpart FF). Provisions in this regulation mandate a 500 ppm limit on emissions from individual refinery drains. The federal requirement has demonstrated that 500 ppm is an achievable standard for existing refinery wastewater processes.

This proposal mandates that each affected facility must either install controls on all wastewater collection system components (drains, manholes and junction boxes) or institute an extremely rigorous inspection and maintenance plan. In addition, both of these options are also subject to a 500 ppm emissions standard.

A. Proposed Amendments and Emissions Reductions

Proposed Sections 8-8-219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230 and 231. The proposed amendments are intended to clarify the definitions in the regulation and seek uniformity with USEPA definitions. No emission reductions are expected from these changes, although they are necessary to make other requirements enforceable.

Proposed Section 8-8-302. The proposed amendment is intended to control the emissions from oil/water separators at refineries to a level consistent with the wastewater collection system. Currently all refinery facilities are meeting and in most cases keeping emissions well below the 1,000 ppm standard, this amendment would have minimal emissions reductions associated with it.

Proposed Sections 8-8-312. The proposed amendment is intended to minimize emissions from wastewater transported in any manner that exposes it to the atmosphere. The provision would have a significant emissions impact as it is intended to control emissions from sewer drains, manholes and junction boxes. This proposed amendment mandates a 500 ppm standard for all Wastewater Collection System Components and ensures an emissions reduction estimated at 65%.

Proposed Section 8-8-313. This section mandates a choice between a District prescribed inspection and maintenance plan for Wastewater Collection Systems components and a compliance schedule for control installation. This program in conjunction with the 500 ppm limit is essential to achieving the projected 1.9 tons of emissions reductions.

Proposed Section 8-8-314. This proposed amendment mandates that all new wastewater Collection System components installed in the future would have water-seals. While it is difficult to predict the emissions reduction that would be achieved by this provision, staff believes that these controls would result in a 65% emissions reduction from all future process drains

Proposed Sections 8-8-402. This section mandates a stringent inspection and maintenance plan for all refineries and the requirements for those refineries who choose alternative compliance plans. This program in conjunction with the 500 ppm limit is essential to achieving the projected 1.9 tons of emissions reductions.

Proposed Section 8-8-403. This section proposes a compliance schedule for the installation of controls on all uncontrolled by December 30, 2007. This provision in conjunction with the provisions of the 300 Section would result in a 65% emissions reduction from Wastewater Collection System components.

Proposed Section 8-8-505. This section contains new recordkeeping requirements associated with other proposals. No emission reductions are expected from these requirements although they are necessary to make other requirements enforceable.

B. SUMMARY OF PROPOSED AMENDMENTS

The following is a summary of proposed amendments to Regulation 8-8. Minor changes are not included.

Summary of Proposed Amendments to Regulation 8, Rule 8

Regulation Section #	Change
101	Changes description and extends the regulation to incorporate collection and transportation systems at refineries.
112	Changes exemption to exclude refinery collection and transportation systems
201	Changes the definition of Organic Compounds consistent with other Regulation 8 rules
204	Modifies definition of vapor tight to be less than 500 ppm as measured with an OVA at the source interface
217	Modify definition of junction box in line with United States Environmental Protection Agency (USEPA) definition
219	Adds new definition of Biological Treatment Unit
220	Adds new definition of Leak Minimization
221	Adds new definition of Leak Repair
222	Adds new definition of Lift Stations in line with USEPA definition
223	Adds new definition of Manholes in line with USEPA definition
224	Adds new definition of Process Drains in line with USEPA definition
225	Adds new definition of Petroleum Refinery
226	Adds new definition of Reaches in line with USEPA definition
227	Adds new definition of Sumps in line with USEPA definition
228	Adds new definition of Trenches in line with USEPA definition
229	Adds new definition of Vent Pipes
230	Adds new definition of Wastewater Collection System
231	Adds new definition of Water Seal or Equivalent Control
232	Adds new definition of Wiers
301.3	Modifies section to apply to organic compounds instead of critical organic compounds.

Regulation Section #	Change
302.3	Modifies section to apply to organic compounds instead of critical organic compounds.
302.4	New language reduces concentration limit for Oil/water separators from 1,000 ppm to 500 ppm total organics as measured with an OVA calibrated with methane
304	Modifies section to limit emissions from sludge during transportation and storage
305.2	Modifies section to apply to organic compounds instead of critical organic compounds.
306.2	Modifies section to apply to organic compounds instead of critical organic compounds.
307.2	Modifies section to apply to organic compounds instead of critical organic compounds.
312	New language requires wastewater can not be transported in a manner which exposes it to the atmosphere and that drains, manholes and junction boxes into sewer lines must be vapor tight
313	New language requires the refineries to choose between a compliance with the standards set in Section 8-8-312 or two alternative compliance provisions
313.1	New language requires the refineries to choose to install controls in compliance with the schedule listed in Section 8-8-403
313.2	New language requires the refineries to choose an Inspections and Maintenance plan. This section also requires that components leaking over 500 ppm be minimized and reinspected within 30 days. If the component passes three consecutive 30-day inspections without leaking in excess of the standard it can be returned to a semi-annual inspection schedule. Also, new language requires that any component found to be leaking over 500 ppm in three inspections be controlled in 30 days
314	New language requires that all future Wastewater Collection System Components at refineries be controlled by water seals or an APCO approved equivalent.
402	New language mandates a Wastewater Collection System Components inspection and maintenance plan by January 1, 2005
402.1	New language requires that all wastewater collection system components must be identified
402.2	New language requires a list and detailed diagrams showing the location of Wastewater Collection System components
402.3	New language requires all wastewater collection system components must be inspected by January 1, 2005. The frequency of inspections for all components thereafter will be semi-annually
402.4	New language requires a plan that provides for a reinspection after minimization or repair of components

Regulation Section #	Change
402.5	New language requires petroleum refineries electing to comply with Section 8-8-313 shall inform the APCO of the subsection for which alternative compliance is sought and shall submit any information required.
402.6	New language requires petroleum refineries that elect to comply with Section 8-8-313.2, the plan must provide for minimization of leaking components and an inspection within 30 days of discovery. The plan must also provide for reinspections every thirty days until the affected component is either controlled or is returned to a semi-annual inspection frequency.
402.7	New language requires records must be maintained as per Section 8-8-505.
403	New language provides a compliance schedule for the control of Wastewater Collection System Components at Petroleum Refineries.
403.1	New language requires that petroleum refineries choosing this option control 25% of all uncontrolled drains by July 30, 2005
403.2	New language requires that petroleum refineries choosing this option control 50% of all uncontrolled drains by December 31, 2005
403.3	New language requires that petroleum refineries choosing this option control 75% of all uncontrolled drains by July 30, 2006
403.4	New language requires that petroleum refineries choosing this option control 100% of all uncontrolled drains by December 30, 2006
505	Requires that refineries keep records for their Wastewater Collection Systems
505.1	Requires records be kept for equipment subject to Sections 8-8-312, 313, 314 and 401
505.2	Requires records of the date, location and concentration recorded during any Wastewater Collection Systems inspection
505.3	Requires that all records pertaining to these inspections be kept on site for five years

IV. EMISSIONS AND EMISSION REDUCTIONS

A. Emissions

To determine the emissions from wastewater collection systems District and CARB staff conducted a series of extensive site visits to the five Bay Area refineries. During these visits, the staff established how the collections system worked at each refinery. It was determined that to estimate the emissions from the collection system, that a combination of emissions modeling (TOXCHEM+ and United States Environmental protection agency (USEPA Water9) and best available control technology/lowest achievable emissions rate (BACT/LAER) emissions determination equations should be used.

Initially, District and CARB staff performed extensive wastewater sampling at all five Bay Area refineries. Utilizing these sampling results emissions estimates for refinery wastewater collection system emissions were developed. TOXCHEM+ emissions modeling based on field data collected (such as drain inventories, systems layouts, wastewater flow-rates) and observed wastewater petroleum concentrations, as identified from the laboratory analytical analysis was then performed. A comprehensive explanation of this modeling and the associated sampling results is provided in the TAD. This modeling provided the following partial emissions estimates for refinery wastewater collection systems:

Table 3: VOC Emission Estimates for Refinery Wastewater Drains, Manholes, and Junction Box Vents (By Refinery)

Refinery	Drain Emissions (tpd)	Manhole Emissions (tpd)	Junction Box Vent Emissions (tpd)	Total [2] (tpd)
1	0.411[1]	0.166	0.126[1]	0.70
2	0.270	0.048	0.168	0.49
3	0.140	0.164	0.168	0.47
4	0.123	0.034	0.084[1]	0.24
5	1.164	0.076	0.168	1.41
Total	2.107	0.488	0.714	3.31

[1] Partial emissions. Additional information is needed to complete the assessment of drain and junction box vents from these facilities.

[2] The emissions reported in this table do not represent the total emissions from the wastewater collection system. As discussed earlier, additional work is needed to estimate emissions from wastewater treatment and TPHd compounds.

By comparison the Districts emissions inventory (see Table 4) lists a total of approximately 1.3 tpd of total VOC emissions from refinery wastewater process drains. These numbers are derived from historical data and sampling, as well as emissions factors. Due to the comprehensive nature of the TAD it is assumed that the VOC estimates it contains, though incomplete, are more reflective of the current situation at Bay Area refineries.

Table 4: VOC Emission Estimates for Refinery Wastewater Collection Systems from the BAAQMD Inventory (By Refinery)

Refinery	Wastewater Collection System Emissions (tpd)
1	0.16
2	0.969
3	0.206
4	0.006
5	0.001
Total	1.342

In evaluating the data in Table 3, it is important to note that the VOC emission estimates for Refineries 1 and 4 are incomplete. For Refinery 1, only part of the refinery was sampled during the source tests due to ongoing maintenance to the wastewater system. This did not allow for the full implementation of the refinery sampling plan at Refinery 1 during the source test period. For Refinery 4, it was discovered after the source tests had been completed that a significant portion of the wastewater collection system was not sampled, and consequently not included in the refinery VOC emission calculation. Therefore, data was not collected to estimate any VOC emissions from vents associated with this portion of the wastewater system.

In addition, this emissions estimate was only developed for the gasoline range compounds (C_2 to C_{10}) identified during sampling. Significant amounts of diesel range materials were found in the wastewater samples analyzed as part of this TAD. The significance of emissions from these materials has not been established as part of this assessment and has been recommended for further study.

B. Emissions Reductions

It is estimated that the implementation of the District's regulatory proposal which includes controls on all wastewater collection system components (drains, manholes and junction boxes) or a District prescribed inspection and maintenance plan and a 500 ppm emissions standard can achieve approximately 1.9 tpd of VOC reductions**.** Emissions reductions estimates are based on control of uncontrolled refinery drains, manholes and junction boxes of 65%.

While not specifically targeted by this regulation, a reduction in VOC will also decrease the amount of toxic air contaminants released by wastewater collection system components. The toxic compounds reduced will include benzene, toluene and xylene (identified as part of the water analysis performed for the TAD). Based on the TAD analysis, other toxic compounds may also be present, including ethylbenzene and naphthalene. It is anticipated that this proposal would also lead to a significant reduction in the emissions of these compounds.

V. ECONOMIC IMPACTS

A. Introduction

In estimating the costs associated with the potential control strategies identified in the previous chapter, both the capital costs and the recurring annual costs were considered.

The methodology used to evaluate the capital costs consisted of considering the annualized capital costs using the capital recovery method. The annualized capital costs were determined using the following equation:

Annualized Cost = (*Capital Recovery Factor*)×(*Capital Expenditure*)

Where:

Capital Expenditure – Equipment and installation costs
Capital Recovery Factor – 14.2% (7% per year over 10 years)

In evaluating the recurring annual costs, cost considerations were provided for such expenditures as operating costs (i.e. utilities, adsorption material replacement, etc.) and potential I&M compliance costs.

Water Seals on Drains

Capital costs associated with sealing inserting water seals in drains are not significant in terms of the cost per emission point. It is estimated that the capital costs are between $400 and $1000 per drain. However, in considering this cost, it is important to consider that a refinery wastewater collection system may contain over one thousand uncontrolled drains.

The total anticipated capital costs to install wastewater water seals on all of the existing uncontrolled refinery process drains in the District are estimated to be between about $3.4 million and $8.6 million, as shown in Table 4. When annualized over ten years, these costs are between $540,000 and $1.5 million per year, including annual I&M costs. Table 5 shows these costs by refinery.

Annual recurring costs are comprised mainly of an anticipated need for an I&M program and equipment depreciation. The I&M program will likely be necessary to ensure the operability of each control device (this is already required for drains under the U.S. EPA's NSPS). It is estimated that the annual costs of employing an inspector, who would be a refinery employee, is about $65,000 per year. It is possible that some refineries will need more than one inspector per facility. Also, each inspector will require the use of monitoring equipment (such as an organic vapor analyzer) which costs about $3,000 per unit. It is assumed that inspectors could be hired part-time or be included in current I&M programs if an annual I&M program for wastewater systems would require less than one full-time position, so pro-rated costs are shown in Table 5. (Note: Appendix M provides a more detailed listing of the cost estimate calculations.)

Table 5: Annual Costs for Water Seals on Uncontrolled Drains[1] (By Refinery)

Refinery	Number of Uncontrolled Drains	Capital Cost (Thousand Dollars)	Annualized Capital Cost (Thousand Dollars per Year)	Annual I&M Costs (Thousand Dollars per Year)	Total Annual Cost (Thousand Dollars per Year over 10 years)
1	1,677	670 – 1,700	100 – 240	10 – 60	100 – 300
2	1,100	440 – 1,100	60– 160	6– 40	70 – 190
3	572[2]	230 – 570	30 – 80	3 – 20	40 – 100
4	500[2]	200 – 500	30 – 70	3 – 20	30 – 90
5	4,750	1,900 – 4,800	270 – 680	30 – 160	300 – 840
Total	8,599	3,400 – 8,600	490 – 1,200	50 – 290	540 – 1,500

1 Numbers may not due to rounding.
2 Estimated from field data.

Sealing Manhole Structures

<u>Capital costs</u> associated with sealing manholes and inserting water seals are typically not significant in terms of the cost per emission point. It is estimated that the capital costs are between $400 and $1000 per manhole. Installing gaskets or seals and plugging holes in manhole covers is a straightforward maintenance operation. However, in considering this cost, it is important to consider that sealing a manhole structure may require replacement of the complete manhole structure due to cracks and gaps in the manhole chimney. Sealing emission sources from a failed manhole structure can require significant underground repair and expense.

The total anticipated capital costs to seal manhole structures on all of the existing refinery manholes in the District are estimated to be between about $2.3 million and $5.8 million, as shown in Table 5. When annualized over ten years, these costs are between $360,000 and $1 million per year, including annual I&M costs. Table 5 shows these costs by refinery.

<u>Annual recurring costs</u> are comprised mainly of an anticipated need for an I&M program and equipment depreciation. The I&M program will likely be necessary to ensure the operability of each control device (this is already required for drains under the U.S. EPA's NSPS). It is estimated that the annual costs of employing an inspector, who would be a refinery employee, is about $65,000 per year. It is possible that some refineries will need more than one inspector per facility. Also, each inspector will require the use of monitoring equipment (such as an organic vapor analyzer) which costs about $3,000 per unit. It is assumed that inspectors could be hired part-time or be included in current I&M programs if an annual I&M program for wastewater systems would require less than one full-time position,

so pro-rated costs are shown in Table 6.

It is important to note that these annual I&M costs are dependent upon the frequency of inspections necessary. As such, costs for a monthly, quarterly and semi-annual inspection program were estimated. These range of annual costs (by refinery) for an I&M program are shown in Table 6, along with the total anticipated annual costs associated with controlling manhole emissions from refinery wastewater systems. (Note: Appendix M provides a more detailed listing of the cost estimate calculations.)

Table 6: Annual Costs for I&M and Sealing Manholes[1] (By Refinery)

Refinery	Number of Manholes	Capital Cost (Thousand Dollars)	Annualized Capital Cost (Thousand Dollars per Year)	Annual I&M Costs (Thousand Dollars per Year)	Total Annual Cost (Thousand Dollars per Year)
1	1,965	790 -2000	110 - 280	11 – 70	120 – 350
2	570	230 -570	30 - 80	3 – 20	35 – 100
3	1941	780 -1900	110 - 280	11 – 70	120 – 340
4	400	160 - 400	20 - 60	2 – 14	25 – 70
5	900	360 - 900	50 - 130	5 – 30	56 – 160
Total	5,778	2,300-5,800	330 - 820	30 - 200	360 - 1000

[1] Numbers may not sum due to rounding.

Water Seals on Junction Boxes

Unlike the case for water seals on drains, the total number of uncontrolled junction box vents at refineries is unknown. Because of this, a conservative approach was taken to assume that all junction boxes would need controls. In reality, this is not likely the case as some junction boxes are already controlled, or are not vented to the atmosphere. As such, the costs identified below are likely higher than could be expected to comply with any future rule.

<u>Capital costs</u> associated with water seals for junction box vents are estimated to be between $2000 and $2500 per vent, based on data provided by refiners. It was indicated that these costs include installation costs. The total anticipated capital costs to install wastewater water seals on all of the existing uncontrolled refinery junction box vents in the District are estimated to be between about $3.9 million and $4.8 million, as shown in Table 6. When annualized over ten years, these costs are between about $560,000 and $750,000 per year, including annual I&M cost. Table 7 also shows these costs by refinery.

<u>Annual recurring costs</u> are comprised mainly of an anticipated need for an I&M program. It is estimated that the annual costs of employing an inspector, who would be a refinery employee, dedicated to monitoring and maintaining the water seals is about $65,000 per year, with potentially more than one inspector being required per facility. Also, each inspector may require the use of monitoring

equipment (such as an organic vapor analyzer) which costs about $3,000 per unit. It is assumed that inspectors could be hired part-time or be included in current (such as fugitive) I&M programs if an annual I&M program for wastewater systems would require less than one full-time position, so pro-rated costs are shown in Table 7.

It is important to note that these annual I&M costs are dependent upon the frequency of inspections necessary. As such, costs for a monthly, quarterly and semi-annual inspection program were estimated. These range of annual costs (by refinery) for an I&M program are shown in the previous tables, along with the total anticipated annual costs associated with controlling uncontrolled junction box vent emissions from refinery wastewater collection systems. (Note: Appendix M provides a more detailed listing of the cost estimate calculations.)

Table 7: Annual Costs for Water Seals for Wastewater Junction Box Vents[1] (By Refinery)

Refinery	Number of Junction Boxes	Capital Cost (Thousand Dollars)	Annualized Capital Cost (Thousand Dollars per Year)	Annual I&M Costs (Thousand Dollars per Year)	Total Annual Cost (Thousand Dollars per Year)
1	655	1,300 – 1,640	190 - 230	4 - 22	190 – 260
2	190	380 – 480	54 – 67	1 – 6	55 – 73
3	647	1,300 – 1,600	180 - 230	4 – 22	190 – 250
4	134	270 - 340	38 - 48	1 – 5	39 – 53
5	300	600 - 750	85 - 110	2 - 10	87 - 120
Total	1,926	3,900 – 4,800	550 - 690	12 - 65	560 - 750

[1]Numbers may not sum due to rounding.

Other types of Vapor Recovery and Control Equipment

While a detailed cost analysis was not performed on all types of emission control devices potentially available for use with wastewater junction boxes, Table 8 provides some generic cost information on other potential vapor recovery and control equipment. In general, it is expected that the costs associated with the application of control equipment to junction box vents are significantly higher than with the use of water seals, although larger emission reductions could be achieved.

Table 8: Operating Costs for Potential Vapor Recovery and Control Equipment (Cubic Feet per Minute)

Control Technology		Capital Cost ($)	Annual Operating Cost ($)
Carbon Absorption		15-120/cfm	10-35/cfm
Thermal Oxidation	Recuperative	10-200/cfm	15-90/cfm
	Regenerative	30-450/cfm	20-150/cfm
Catalytic Oxidation	Fixed bed	20-250/cfm	10-75/cfm
	Fluidized Bed	35-220/cfm	15-90/cfm
Condensation		10-80/cfm	20-120/cfm

Source: Shen, Almon M. "Stationary Source VOC and NOx Emissions and Controls", Presentation at the 1995 Air Pollution Prevention Conference, Taipei, Taiwan, October 1995.

Performance Based Standards

While the costs associated with implementing performance based standards are difficult to quantify, in general, the establishment of performance based standards provides one of the lowest cost options for control. This is because performance based standards allow each refiner to utilize the control option or options that result in the lowest cost (both in terms of capital costs and operating costs). As such, it is believed that the costs associated with performance based standards would be in the range of, or even less than, the costs identified above for specific prescriptive control strategies.

Hard Piping

The costs associated with hard piping are uncertain at this time. This is because additional work is needed to identify the specific requirements at each refinery if this control strategy was considered. Costs would be dependent on a number of variables, including the physical characteristics of the piping necessary (length, diameter, material), as well as any necessary construction requirements, such as minimum required depth and soil/ground conditions in the area.

B. Cost-Effectiveness

This section describes the overall cost-effectiveness to control emissions from drains, manholes and junction box vents with water seals.

Based on the estimates of 3.3 tpd of VOC emissions (Table 3) from drains, manholes, and junction box vents, it is expected that 1.9 tpd of emission reductions can be achieved by sealing manholes and installing water seals in drains and junction box vents. The estimated total annual costs for control at each of the refineries in the District is in the range of $1.4 million to $3.3 million. It is estimated that the cost-effectiveness to reduce emissions from drains, manholes, and junction box vents ranges from $1900 to $4200 per ton of VOC reduced. This is within the range of cost-effectiveness determined for other VOC control measures adopted by the District, as well as by the ARB.

Additionally, in considering cost-effectiveness, it is important to consider that the emission estimates for two of the refineries, as discussed, are not complete, and that characterization of emissions from TPHd in the wastewater still needs to be evaluated. As such, the cost-effectiveness numbers above are conservative, and likely to improve as additional data is developed. In addition, as discussed above, it is likely that all of the junction box vents will not need controls. As such, the capital cost estimates, and by default the cost-effectiveness numbers, are likely overestimated and likely to improve with additional information.

C. Socioeconomic Impacts

Section 40728.5 of the California Health and Safety Code (H&SC) requires districts to assess the socioeconomic impacts of amendments to regulations that, "...will significantly affect air quality or emissions limitations." TO BE DEVELOPED…

D. Incremental Costs

Under California Health and Safety Code Section 40920.6, the District is required to perform an incremental cost analysis for a proposed rule under certain circumstances. To perform this analysis, the District must (1) identify one or more control options achieving the emission reduction objectives for the proposed rule, (2) determine the cost effectiveness for each option, and (3) calculate the incremental cost effectiveness for each option. To determine incremental costs, the District must "calculate the difference in the dollar costs divided by the difference in the emission reduction potentials between each progressively more stringent potential control option as compared to the next less expensive control option."

In considering incremental cost-effectiveness, it is important to consider that the emission estimates for two of the refineries, as discussed in the TAD, are not complete, and that characterization of emissions from wastewater treatment and emissions from TPHd in the wastewater still need to be evaluated. As such, the cost-effectiveness numbers bellow are conservative, and the cost-effectiveness of control measures will improve as additional data is developed.

Incremental Cost-Effectiveness for Waterseals on Drains

Based on the estimates of 2.1 tpd of VOC emissions (Table 3) from refinery drains, it is expected that 1.37 tpd of emission reductions can be achieved. With estimated total annual costs for control of all uncontrolled drains at each of the refineries in the District of $540,000 to $1.5 million (Table 4), it is estimated that the cost-effectiveness to require water seals on uncontrolled drains is between $1,100 and $3000 per ton of VOC reduced. This is in the range of cost-effectiveness determined for other VOC control measures adopted by the District, as well as by the ARB.

Incremental Cost-Effectiveness for Sealing Manholes

Based on the estimates of 0.49 tpd of VOC emissions (Table3) from refinery manholes, it is expected that 0.32 tpd of emission reductions can be achieved. With estimated total annual costs for control of all unsealed manholes at all of the refineries in the District of $360,000 to $1 million (Table 5), it is estimated that the cost-effectiveness to seal manholes is between $3100 and $8800 per ton of VOC reduced. This is in the range of cost-effectiveness determined for other VOC control measures adopted by the District, as well as by the ARB.

Incremental Cost-Effectiveness for Waterseals on Junction Boxes

Based on the estimates of 0.71 tpd of VOC emissions (Table 3) from junction box vents, it is expected that 0.46 tpd of emission reductions can be achieved. With estimated total annual costs for control of all junction box vents at all of the refineries in the District of $560,000 to $750,000 (Table 6), it is estimated that the cost-effectiveness to require water seals on junction box vents is between $3300 and $4400 per ton of VOC reduced. This is in the range of cost-effectiveness determined for other VOC control measures adopted by the District, as well as by the ARB.

E. Staff Impacts

Implementation of the proposed amendments will have a moderate impact on the District's resources. These changes are necessary to achieve the necessary emission reductions and to verify compliance.

ENVIRONMENTAL IMPACTS

Pursuant to the California Environmental Quality Act, the District's environmental consultant, Environmental Audit, Inc., is preparing an initial study for the proposed rule amendments to determine whether rule adoption would result in any significant environmental impacts.

One of the perceived impacts of this proposal would be a decline in wastewater quality. Through field visits, interviews and the wastewater workgroup, staff has ascertained that each refinery treatment system has been designed to cope with large fluxuations in influent. Based on this excess capacity and on the review of literature as part of the TAD, staff believes that the entrainment of VOC's in the water as a result of this measure will not adversely affect water quality standards.

REGULATORY IMPACTS

Section 40727.2 of the Health and Safety Code requires an air district, in adopting, amending, or repealing an air district regulation, to identify existing federal and district air pollution control requirements for the equipment or source type affected by the proposed change in district rules. The district must then note any differences between these existing requirements and the requirements imposed by the proposed change.

Existing Requirements	New Requirements
Reg. 8-8 requires that fixed roof Oil/water separators at refineries larger than or equal to 18.9 liters per second must meet a 1,000 ppm leak standard	Regulation 8-8 will now require that fixed roof Oil/water separators at refineries larger than or equal to 18.9 liters per second must meet a 500 ppm leak standard
Under Title 40 CFR Part 60, Subpart QQQ, junction boxes on new sources at refineries shall be equipped with a cover and may have an open vent	Regulation 8-8 will now require that new or existing junction boxes at refineries be controlled with a sealed closed cover but may have an open vent.
Under Title 40 CFR Part 60, Subpart QQQ, standards for drains, junction boxes and oil/water separators do not apply during startup, shutdown or Malfunction.	Regulation 8-8 will now require that control and emissions standard apply during these periods
Under Title 40 CFR Part 60, Subpart QQQ, broken seals or gaps on junction boxes must be repaired within 15 days.	Regulation 8-8 will now require that upon discovery of any leak over 500 ppm on junction boxes that leak must be minimized within 24 hours.
Under Title 40 CFR Part 60, Subpart QQQ, broken seals or gaps on drains must be repaired within 15 days	Regulation 8-8 will now require that upon discovery of any leak over 500 ppm on drains that leak must be minimized within 24 hours.
Under Title 40 CFR Part 60, Subpart QQQ, broken seals or gaps on oil/water separators must be repaired within 15 days	Regulation 8-8 will now require that upon discovery of any leak over 500 ppm on oil/water separators that leak must be minimized within 24 hours and repaired within three days.
Under Title 40 CFR Part 60, Subpart QQQ, the EPA Administrator will determine if a control measure meets equivalency for a process.	Regulation 8-8 will now require that the APCO also approve equivalency.

Under Title 40, CFR, Part 61, Subpart FF, the benzene NESHAP regulations require visual checks on all controlled water seal drains identified as containing benzene	Regulation 8-8 will now require that all drains also be subject to biannual VOC emissions testing.

Based on this review staff believes that no conflict or duplication of District or Federal requirements exists and that the amendments to Reg. 8-8 should be adopted.

CONCLUSION

A working group was formed that included representatives from California Air Resources Board, Industry, the Regional Water quality Control Board, Communities for a Better Environment (CBE), and District staff. The workgroup has met seven times to discuss technical issues related to this regulation. The issues discussed included refinery sampling plans and modeling, wastewater emissions estimation, regulatory concepts and planning for analysis of refinery wastewater treatment systems.

The main issue raised in the workgroup was in relation to the refinery wastewater treatment systems. Two schools of thought surfaced with CBE requesting immediate control action on wastewater treatment processes in addition to control of the collection system and the refineries requesting that the District staff study emissions from the treatment process prior to proposing controls. Staff are of the opinion that, based on the efforts made by industry to quantify emissions from the collection portion of the system, the ongoing workgroup process is the first step towards understanding and quantifying emissions from refinery waste water treatment.

The proposed amendments to Regulation 8, Rule 8: Wastewater (Oil – Water) Separators will exceed the commitment for study made as part of 2001 Ozone Attainment Plan. It is intended to limit the amount of organic compounds released during the collection of refinery wastewater during transport to on-site treatment. Pursuant to the Health and Safety Code Section 40727, new regulations must meet necessity, authority, clarity, consistency, non-duplicity and reference. The proposed regulation is:

- Necessary to protect public health by reducing ozone precursor emissions. The amendments also reduce exposures to toxic air contaminants.
- Authorized by California Health and Safety Code Section 40702.
- Clear, in that the new regulation specifically delineates the affected industry, compliance options and administrative requirements for industry subject to this rule,
- Consistent with other District rules, and not in conflict with state or federal law,
- Non-duplicative of other statutes, rules or regulations, and
- The proposed regulation properly references the applicable District rules and test methods and does not reference other existing law.

While this current revision is targeted at refineries only, it is recommended that other industries subject to this rule be studied and if necessary controlled in a similar manner so that emissions reductions can be obtained. Also, both the TAD and this rule making effort identified a number of other areas where further potential emissions reductions could be achieved. These are as follows:

- Better characterization of the contribution of heavier hydrocarbons (i.e., diesel fuel, fuel oils, etc.) in the wastewater stream to VOC emissions from the wastewater collection system.
- Study of emissions from wastewater treatment
- Study of emissions from oil-water, or API, separators
- Study of emissions from coke cutting operations and vacuum trucks

REFERENCES

1. California Air Resources Board Draft Technical Assessment Document "Potential Control Strategies to Reduce Emissions for Refinery wastewater Collection and Treatment Systems" January 2003.

2. Bay Area Air Quality Management District, "Best Available Control Technology (BACT) Guideline for Water Treating – Oil/Water Separator", October 1991.

3. South Coast Air Quality Management District, "Proposed Amended Rule 1176 – VOC Emissions From Wastewater Systems", Final Staff Report, September 13, 1996.

4. United States Environmental Protection Agency, AP-42 "Waste Water Collection, Treatment And Storage", January 1995.

COMMENTS AND RESPONSES

To be added