Chapter 7 Biosolids

CHAPTER OVERVIEW

Regarding the biosolids presentation in Chapter 7, the primary driver is the management of the asset in conjunction with the Federal, State and local regulatory guidelines. Therefore, the thrust of this chapter will be to introduce and explain the regulatory guidelines and present alternative methods for treatment and utilization of biosolids.

Under current conditions sludge produced at the Roger Road Wastewater Treatment Plant (WWTP) is thickened and digested at the Roger Road WWTP, then pumped to dewatering facilities at the Ina Road Water Pollution Control Facilities (WPCF). Sludge produced at the Ina Road WPCF is thickened and digested at the Ina Road WPCF, then combined with the thickened/digested sludge from the Roger Road WWTP, prior to dewatering at the Regional Biosolids Facility adjacent to the Ina Road WPCF. Sludge from the Outlying Facilities, with the exception of the Green Valley WWTP, are transported for ultimate treatment at the Regional Biosolids Facility. The Regional Biosolids Facility presently treats biosolids to Class B, with limited reuse options. To enhance reuse options it is recommended the biosolids facilities be upgraded to produce Class A biosolids with its resultant enhanced reuse options. There is also some interest in having all of the biosolids in the Metropolitan Area processed at the Regional Biosolids Facility, in lieu of having digestion facilities at the Roger Road WWTP. A comprehensive study to determine the most cost effective methods for processing of biosolids, as well as the best option for the processing location(s) is recommended. This study should evaluate:

- Types of solids handling (biosolids) facilities which should remain at Roger Road WWTP.
- Biosolids pumping facilities from Roger Road WWTP to the Ina Road WPCF.
- Upgrades at the Ina Road WPCF to enhance biosolids treatment capacity, as well as produce Class A biosolids.
- Available local uses for Class A biosolids in various disposal forms (e.g., dewatered cake, dried pellets, etc.).
- Options for biosolids handling at Outlying Treatment Facilities.

CHAPTER 7.0 BIOSOLIDS

A description of the existing biosolids treatment facilities at both Roger Road WWTP and Ina Road WPCF is provided in Chapters 5.1 and 5.2 respectively. Currently, after thickening, digestion, and dewatering (at the Regional Biosolids Facility located at the Ina Road WPCF), biosolids are loaded into trucks and hauled to land application sites for beneficial use. Biosolids are nutrient-rich organic by-products resulting from wastewater treatment that can be beneficially reused. At wastewater treatment plants, solids are separated from the wastewater and transformed into biosolids through the use of physical, chemical, biological and heat processes. These processes reduce the quantity of solids, through conversion to water and methane gas, and also reduce the levels of odor and bacteria in the final product, which then undergoes testing to ensure effective treatment before it can be used.

Currently, 46 states allow for the beneficial use of biosolids in agriculture, forestry and soil improvement projects. Several states, including Arizona, are researching the use of biosolids to reclaim open pit mines and gravel pits. Besides application on farmland, other uses of biosolids include application at plant nurseries, parks, golf courses, home lawns and gardens, and highway medians. Biosolids contain essential plant nutrients, which are released gradually when land applied. Organic matter allows soil to breathe as well as hold more water, which results in decreased water runoff and soil erosion.

In order for biosolids to be used, they must undergo extensive treatment. The processes used for solids treatment have evolved from years of scientific research. They must also meet State and Federal quality standards for safe application. The amount of treatment depends on the desired classification of biosolids are being land applied. There are two classes of biosolids: Class B and Class A. Class B biosolids receive treatment to reduce pathogens, or disease-causing organisms. In addition to treatment, they are subject to management practices such as application setbacks, buffer zones, and tilling into the soil soon after application. Also, the site where the biosolids are applied must be protected from public access for one year following the application. Class A biosolids undergo such rigorous treatment prior to application that they are exempted from State requirements for management practices.

In February 1978, the Regional Metropolitan Tucson Wastewater Management System Facility Plan recommended the biosolids derived from the treatment of wastewater receive anaerobic digestion and be reused as a soil conditioner for agriculture. The selected sludge management plan involved anaerobic digestion at both the Roger Road WWTP and the Ina Road WPCF and conveyance to a centralized biosolids handling facility (Regional Biosolids Facility), for moisture reduction, storage, handling and disposal. This eliminated the use of sludge drying beds at Roger Road WWTP facility. A sludge pumping station was constructed at Roger Road WWTP facility with a 5.3-mile long 8-inch force main connecting to the receiving tanks at the Regional Biosolids Facility located adjacent to Ina Road WPCF facility. This facility included sludge receiving tanks, centrifuges, a polymer dosing system, centrate holding tanks, centrate transfer pumps, sludge pumps, a covered sludge storage pond, and a facility for loading biosolids into tanker trucks for land application.

The Regional Biosolids Facility began operation on July 7, 1987 at the Ina Road WPCF. Sludge is routinely pumped from the Roger Road WWTP and Ina Road WPCF facilities, centrifuged in the Regional Biosolids Facility, loaded into trucks for land application by a private contractor on agricultural fields in Pima and Pinal counties. Centrate from the facility is pumped back to the headworks of the Ina Road WPCF facility for processing with other wastewater entering the facility.

Currently, the daily combined biosolids production from Roger Road WWTP and Ina Road WPCF facilities is about 24 dry tons with a projected increase of about 2.5 percent each year. This includes the biosolids from Mt. Lemmon Wastewater Treatment Facility (WWTF), Avra Valley WWTF, Marana WWTF, Randolph Park Water Reclamation Facility (WRF) and the septage receiving station at Roger Road WWTP. Biosolids from Mt. Lemmon WWTF, Avra Valley WWTF and Marana WWTF are combined with the influent to the Ina Road WPCF for further treatment and disposal. Waste activated sludge from Randolph Park WRF is mixed with the wastewater in the sewers downstream of the Randolph Park WRF and carried in these sewers to Roger Road WWTP. Biosolids from Avra Valley WWTF is mixed with the sewage tributary to Roger Road WWTP. The septage from the receiving station is mixed with the influent to Roger Road WWTP facility at the headworks.

The Green Valley WWTF produces about 20 dry tons sludge per month, which is expected to double in the next five years. The sludge is dried in the sludge drying beds to make it Class A biosolids, which can be used for a number of different options, including cover material for landfills or for mine tailings reclamation.

Even though land application of biosolids on agricultural fields is one of the best uses of this byproduct of wastewater treatment, it is necessary for PCWMD to develop options and alternatives for the future regarding this critical residuals disposal responsibility. Alternatives could include mine tailing reclamation, composting and landfill cover as described later in this chapter. As more farming areas get developed into residential areas, the biosolids will have to be hauled further away for reuse on other available farmlands to avoid odor problems and application complaints. The increased hauling distance and the shrinking farmland availability will make the land application method more expensive in the future. In addition, public perception of biosolids land application has not always been positive, as the recent biosolids disposal bans in California and other states have shown. However, biosolids are in fact produced and utilized under a very strict regulatory environment, which are designed to protect public safety, as shown in the following section.

Biosolids Regulatory Programs

EPA first developed biosolids management regulations under the 1972 Federal Water Pollution Control Act. In 1977, Congress amended the Act to develop regulations containing guidelines to identify alternatives for biosolids use and disposal, identify concentrations of pollutants that would interfere with each use, and specify what factors must be accounted for in determining the methods and practices applicable for each identified use. In 1987, Congress established a timetable for developing biosolids use and disposal guidelines. EPA promulgated the Standards for the Use and Disposal of Sewage Sludge (Code of Federal Regulations, Title 40, Part 503) in 1993.

Arizona Administrative Code (AAC) R18-9-1001 (et seq.) became effective on December 5, 2001. These rules initiated standards to be used when biosolids are applied to the land as a fertilizer or a beneficial soil amendment. The standards establish biosolids quality and management practices that protect the public health and the environment.

Treatment, use and disposal of biosolids resulting from wastewater treatment processes are regulated under both Federal and State law. ADEQ operates the delegated state program for biosolids (18 AAC Chapter 9, Article 10). Biosolids generators and applicators must be in compliance with both standards. ADEQ has also received delegated authority for the AZPDES biosolids permit program from the EPA.

In the US, approximately 60 percent of all biosolids generated are recycled for beneficial use (Biosolids Generation, Use, and Disposal in the United States; USEPA, 1999; EPA 530-R-99-009). Many western states with abundant agricultural land recycle a much higher percentage as a

soil amendment and fertilizer. Agricultural land is the primary outlet for biosolids recycling, but further processing into compost or dried fertilizer products is also common. Landfill disposal and incineration are diminishing due to cost and regulatory limits, while land application has been increasingly common.

The EPA through 40 CFR Part 503 regulates biosolids land application at the Federal level. The 503 Rule is designed to protect public health and the environment from adverse effects that may result from use/disposal practices of biosolids. The Rule provides standards for pollutant limits, operational standards, management practices, and monitoring, record keeping and reporting requirements. The regulatory requirements for biosolids include treatment requirements to meet Class A and Class B standards, as well as end use and disposal requirements.

The Rule is self-implementing and imposes requirements on the generators and entities further treating, distributing, or using the biosolids. Agencies not complying with the requirements are in violation and can be subject to enforcement action from the EPA.

To land apply biosolids, the Rule requires the biosolids be non-hazardous and satisfy risk-based requirements for pollutant limitations and be treated under operational standards to achieve pathogen and vector attraction reduction. In addition, there are general requirements for management practices, monitoring, and reporting. All requirements are described in the regulation as well as guidance documents such as "The Plain English Guide for the EPA Part 503 Biosolids Rule (EPA/832/R-93/003)".

According to federal regulations (40 CFR 503), biosolids samples should be analyzed for the parameters listed in Table 7.1.1.

The nitrogen, phosphorus and potassium content of the biosolids are important when applying biosolids at agronomic rates. Nitrogen content can vary significantly in the biosolids depending on its source, age, and treatment history. The concentration levels of these nutrients should be determined from samples taken immediately before biosolids are applied because stored biosolids can lose nitrogen rapidly. Therefore, it is important that the real nitrogen content of the biosolids is known to avoid under- or over-application. The assumptions used to determine the available nitrogen in the biosolids were:

- 30 percent of the organic nitrogen will be available.
- 50 percent of the ammonia nitrogen will be available.
- 100 percent of the nitrate-nitrite nitrogen will be available.

Table 7.1.1 Sampling Requirements for the EPA 503 Sludge Regulations

Parameter	Units
Arsenic	mg/kg dry weight
Beryllium	mg/kg dry weight
Cadmium	mg/kg dry weight
Chromium	mg/kg dry weight
Copper	mg/kg dry weight
Lead	mg/kg dry weight
Mercury	mg/kg dry weight
Molybdenum	mg/kg dry weight
Nickel	mg/kg dry weight
Selenium	mg/kg dry weight
Zinc	mg/kg dry weight
Total nitrogen	percent dry weight
Nitrate nitrogen	percent dry weight
Ammonia nitrogen	percent dry weight
Phosphorus	percent dry weight
Potassium	percent dry weight
pH	standard units
Total solids	percent
Volatile solids	percent
PCBs	g/kg

Under the Part 503 rule, ceiling concentrations, cumulative pollutant loading rates, exceptional quality or "clean biosolids," and annual pollutant loading rate have been established for heavy metals. Table 7.1.2 lists the acceptable levels for land application based on Federal regulations. These regulations are somewhat different from the State on the soil cation exchange capacity (CEC). These rates are used to determine site life, which is the number of years that biosolids with a uniform metal content could be applied to a specific site.

Table 7.1.2 New Federal Regulations (Part 503) for Heavy Metals[1]

Parameter	Ceiling (mg/kg)	Cumulative loading (kg/ha)	Monthly average concentration (mg/kg)	Annual pollutant loading rate (kg/ha/yr)
Arsenic	75	41	41	20.
Cadmium	85	39	39	1.9
Copper	4,300	1,500	1,500	75
Lead	840	300	300	15
Mercury	57	17	17	.085
Molybdenum	75	---[2]	---[2]	---[2]
Nickel	420	420	420	21
Selenium	100	100	100	5.0
Zinc	7,500	2,800	2,800	140

1. From 40 CFR 503 (include date of source requirement).
2. When 40 CFR 503 was amended in 1994 it deleted pollutant limits for molybdenum in biosolids applied to land but retained the molybdenum ceiling limits.

The Rule sets limits for nine metals, including ceiling limits and more stringent pollution concentration (PC) limits. Biosolids meeting PC limits can be applied to land without tracking cumulative loads to the site. If metals exceed PC limits, but are below ceiling limits, biosolids can be applied until the total load to the site approaches cumulative limits for the most limiting metal. If any metal exceeds the ceiling concentration, land application is prohibited. High metals concentrations have become a rare occurrence in the last 20 years as source control programs have been implemented. Few biosolids programs would be expected to exceed PC limits let alone ceiling concentrations in today's operations.

Biosolids must also meet pathogen and vector attraction reduction standards prior to land application. Pathogen reduction assures protection of public health and the environment under specific use conditions. There are two categories of pathogen reduction standards for biosolids; Class A and Class B. Class A biosolids must undergo treatment that reduces pathogens below detectable levels. Processes that generate Class A biosolids include composting, thermal drying, high temperature processes (combined with prescribed batch holding times), and some alkaline treatment systems. Class A biosolids can be land applied without restrictions with respect to crop type or public access.

Class B biosolids have received sufficient treatment to ensure protection of public health under specific use conditions. For example, Class B biosolids are not applied to public access areas, or to crops harvested for direct human consumption. About 40 percent of all biosolids produced in the United States are used as Class B biosolids, making this the most common form of biosolids recycling. Typical processes generating Class B biosolids include aerobic and anaerobic (mesophilic temperature) digestion.

All recycled biosolids must be applied at appropriate agronomic rates where available nutrients match crop needs. Special provisions can be made for reclamation projects where application rates may exceed annual crop needs on a one-time for purposes of soil improvement. Monitoring and record keeping is required to document that biosolids treatment, quality and management is consistent with applicable regulations.

Treatment Process and Disposal

Current Conditions

At the Roger Road WWTP and Ina Road WPCF, the primary sludge and secondary sludge are thickened and anaerobically digested. Anaerobic digestion is one of the approved methods of pathogen reduction, which produces Class B biosolids. These biosolids can be land applied as long as various heavy metal concentrations in the biosolids are less than the limits specified in Table 1 in 40 CFR 503 regulations, and meet at least one of the vector attraction reduction requirements specified in the regulations. The 503 rules also specifies what crops may be grown in the biosolids applied land and when the crop may be harvested. Guidelines and rules have been published for the use of Class B biosolids on farmlands. These include rules about the minimum distances to be set aside from the wells, dwelling units, and public right-of-way where the biosolids can be stored or applied.

Currently, about 63 million gallons per day (MGD) of wastewater is treated at the Roger Road WWTP and Ina Road WPCF, generating an average of 350,000 gallons per day of Class B biosolids per day. The processing and disposal of biosolids constitute some of the highest cost items in wastewater treatment operation. The existing regional biosolids management infrastructure and equipment have operated since 1987.

PCWMD retained Engineering and Environmental Consultants, Inc. (EEC) to evaluate the status of the biosolids-processing infrastructure and provide recommendations for improving the biosolids handling and disposal facilities. The following is a partial summary of their recommendations from their June 2002 report.

The evaluation revealed the following deficiencies in the biosolids handling system:

- Cavitation in the sludge pumps at Roger Road WWTP.
- Lack of backup equipment which has affected the scheduled maintenance.
- Degradation of the interior lining at pipe joints in the 8-inch Ductile Iron (DI) force main conveying sludge from Roger Road WWTP to Ina Road WPCF.
- Lack of sufficient capacity in the centrate return sump and pumping system complicated by struvite build up.
- Inadequate sludge cake pumping equipment.
- Inadequate odor scrubber at the centrifuge facility.
- Aging biosolids storage bladder and cover.
- Emissions of noxious odors from biosolids transfer manifold system.
- Substandard electrical system at the biosolids transfer area.
- Lack of maintenance in the biosolids storage and transfer facility.

Future Treatment Options

PCWMD is interested in the possibility of transferring all the solids handling facilities to the Ina Road WPCF in lieu of having facilities at both the Ina Road WPCF and the Roger Road WWTP. To this end, it is expected that the following modifications will be required:

1) Decommission the existing digestion process at the Roger Road WWTP. These digesters are in need of major repairs, and it may be more cost effective to build replacement units at the Ina Road WPCF.
2) Modify one or two of the existing digesters at the Roger Road WWTP to act as sludge holding tanks.
3) Upgrade solids pumping/piping facilities for pumping thickened undigested solids from the Roger Road WWTP to the Ina Road WPCF.
4) Provide a second solids line interconnecting the Roger Road WWTP and the Ina Road WPCF or provide an option, in case of emergency, or pump the solids into the proposed plant interconnect line.
5) Install additional digestion facilities at the Ina Road WPCF to accommodate the Roger Road WWTP solids.
6) Upgrade digestion facilities at the Ina Road WPCF to allow production of Class A biosolids.
7) Upgrade dewatering facilities at the Ina Road WPCF to increase solids concentration of the dewatered sludge and minimize transport and disposal costs.
8) Upgrade ancillary solids handling facilities, as needed, to provide for Class A biosolids and allow handling of the increased solids concentration.
9) Possible upgrade of the treatment process at the Ina Road WPCF to accommodate the additional centrate.
10) Evaluate modifications to the digester gas fueled co-generation facility to accommodate the additional gas expected from digesting Roger Road WWTP sludge at the Ina Road WPCF.

The above modifications should be further investigated as part of a comprehensive study to verify the viability of these modifications, as well as, the estimated cost impacts.

Future Disposal Options

It is generally accepted that biosolids reuse is the preferred method of disposal to make use of the valuable nutrient it contains. The following paragraphs discuss the range of general disposal options, ranging from the simplest landfilling to some of the most regulatory intensive. There are several alternatives for beneficial utilization which are described in the following section.

Landfill Disposal

For landfill disposal, biosolids do not need to be Class A or Class B; however, landfill regulations require the biosolids be non-hazardous and pass the paint filter test to limit the moisture content of the material received at the landfill. This method of biosolids disposal will consume the capacity of sanitary landfills. Biosolids should be dewatered prior to hauling to landfill in order to: 1) ensure the biosolids can meet the paint filter test; and 2) reduce the cost of haul and disposal. Most landfills charge tipping fees on the basis of wet tons disposed.

Land Application

Biosolids land application includes the beneficial use on agricultural land to supply nutrients and replenish soil organic matter. It improves soil properties, such as texture and water holding capacity, which make conditions more favorable for root growth and increases the drought tolerance of vegetation. Biosolids can also serve as an alternative or substitute for expensive chemical fertilizers. The nutrients in the biosolids offer several advantages over those in inorganic fertilizers because they are organic and are released slowly to growing plants. These organic forms of nutrients are less water-soluble and, therefore, less likely to leach into groundwater or run off into surface waters.

Land application is well suited for managing biosolids as it offers cost advantages, benefits to the environment, and value to the agricultural community. In Southern Arizona, with its dry and mild climate, biosolids can be land applied throughout the year, requiring minimal storage capacity. The disadvantage of land application is potential public opposition, particularly when the beneficial use site is close to residential areas. The primary reason for public concern is odor and the resultant perception that odors signify the presence of pathogens. Most odors associated with land application are a nuisance rather than threat to human health or the environment. Odor controls focus on reducing the odor potential of the biosolids or incorporating them into the soil. Stabilization processes such as digestion can decrease the potential for odor generation.

Runoff from rainfall may also carry excess nutrients to surface water. However, this potential impact is mitigated by proper management practices, including the application of biosolids at agronomic rates, and maintenance of buffer zones between application areas and surface water bodies and soil conservation practices minimize impacts to surface water.

Agencies which operate a land application program must treat their sludge to reduce pathogen and vector attraction potential. After dewatering, the biosolids are loaded into transport vehicles, transferred to application equipment, and then applied. The land application operation, whether operated by the agency or a private contractor, must comply with State and local requirements as well as Federal regulations, which include calculation of agronomic rates and record keeping.

The biosolids generator should also allocate time to communicate with farmers, landowners and neighbors about the benefits of biosolids recycling. Control of odors, along with a viable monitoring program, is most important for public acceptance.

Minetailing Reclamation

Human activities, such as strip mining, often disturb native landscapes and underlying soils. Heavy equipment used in strip mining can severely damage soil structure by removing top soils or by pulverizing and compacting soils. Following this damage, soils are often unable to support plant life due to lack of nutrients and organic matter, compaction, altered pH and other ecosystem changes.

Disturbed soils can be restored and revitalized through the addition of organic matter. Nutrient-rich, organic biosolids can replace lost topsoil and improve soil fertility and stability, thus decreasing erosion and aiding in revegetation.

Biosolids have been used successfully to reclaim surface strip mines and mine tailings. One time or infrequent applications of large quantities of biosolids have been used to increase the amount of nutrients and organic matter in the poor or damaged soil. The nutrients in the biosolids “jump-start” the micro-biotic activity in the soil and provide a pool of nutrients from which the plants can draw for immediate growth as well as on a long-term basis. The organic matter that enters the soil from the biosolids allows the soil to become aerated and replaces lost or compacted topsoil, especially when plowed into the surface of the existing soil and help establish vegetation. Most nutrients (nitrogen, phosphorus, potassium, sulfur, zinc and boron) will remain in the plant root zone bound to organic matter much longer than would traditional inorganic, commercial fertilizers.

Since 1996, Pima County has been involved in an long-range research and demonstration project with the ASARCO Mission Mine Facility and the University of Arizona to evaluate the effective utilization of biosolids to re-vegetate minetailings. This project has been very successful in accomplishing its objectives and has significant potential for future large-scale disposal of biosolids from the Metropolitan Treatment Facilities.

Drying & Pelletizing

Heat drying is one of the processes to significantly reduce pathogens (PSRP) defined in Appendix B to Part 503. This means that dried biosolids, if less than 10 percent moisture, are considered to be Class A.

Sludge leaving wastewater plants is often dewatered on site through either belt filter presses, centrifuges, or some other process. This initial dewatering is vital to economics for the heat drying by reducing the energy and fuel required for the process. Wastewater sludge is fed to a dryer typically at 15 to 25 percent solids.

Two main modes of biosolids drying that can be used in the heat drying/pelletization process are direct dryers and indirect dryers. Direct dryers, such as flash dryers, rotary dryers, and fluid-bed dryers, involve bringing the feed material into direct contact with a heated air stream at 750° F to 900° F to facilitate evaporation. The dried sludge is over 90 percent solids, which allows for easy handling and storage. The unit heat rate of the system is approximately 1,450 to 1,550 BTU/lb of water evaporated. Direct dryers typically produce a marketable product when the sludge is digested prior to the dewatering process.

Indirect dryers, such as Paddle dryers, hollow-flight dryers, disc dryers, and effect evaporation dryers use a heat transfer medium (typically steam) to conduct heat through the shell to heat biosolids to temperatures of approximately 212°F. In this process, the biosolids never come into direct contact with the heat source; they are moved through the tube by a heated auger. As outside air (oxygen) does not enter the drying area, it eliminates the chance of combustion within the system. The moisture removed from the biosolids is collected as steam and removed from the dryer using a blower.

A critical aspect of any drying technology is its ability to produce pelletized biosolids that are marketable as a fertilizer with respect to size, dryness, elimination of dust, microbiological cleanliness, and durability. Handling of dried biosolids in enclosed spaces creates safety issues related to dust and resulting explosion hazards. These hazards can be mitigated with proper engineering and operation, including providing and maintaining nitrogen blanketing systems for dried solids storage.

It must be recognized that dried pellets of sludge will be substantially different than dewatered cake; most significantly, there will be very little moisture with the sludge. For this to be a viable technology, potential users of the dried biosolids pellets must be identified, and if possible, commitments with Pima County made to take the dried pelletized material.

Biosolids Composting

Biosolids are a nutrient-rich organic material and a renewable resource that can be safely returned to the soil. Biosolids, in combination with other renewable resources such as, yard trimmings, leaves, and food wastes, can be composted to produce a Class A soil conditioner. Composting provides high-grade products that can be used by farmers, horticulturists, landscapers and nurseries.

Composting can be achieved in various processes including windrow, aerated static pile or en-vessel systems. Each can be designed to handle a wide variety of organic materials, such as biosolids, green waste, animal manures, etc., and turn them into high quality, marketable end products.

Appendix B to Part 503, Composting indicates the biosolids can satisfy the Class A pathogen reduction requirements when composted using (either an en-vessel or static aerated pile process) when the

temperature of the biosolids is maintained at 55º C or higher for three days. Alternatively, using the windrow composting method can be used by, maintaining the temperature of the biosolids at 55º C or higher for at least 15 days during which the windrow must be turned at least five times.

In summary, all the above applications provide effective disposal of the biosolids residuals; however, going forward with most of these alternatives will require PCWMD to improve the quality of the biosolids residuals to meet the requirements for Class A biosolids. Class A biosolids will allow the Department the regulatory and technical flexibility to utilize a wide variety of disposal options at favorable cost to PCWMD and the ratepayers ensuring Class A biosolids have the following advantages:

- Increase in the number of parties (i.e., potential users of the biosolids) interested in participating in the biosolids management program.
- Decrease volume of biosolids production.
- Reduce hauling effort and associated costs.
- Lower monitoring and reporting requirements.
- Reduce administrative costs.
- Increase options for reuse of the material such as commercial fertilizer and landfill cover material usable in parks and mine tailings.

Therefore, PCWMD should plan to retrofit the existing biosolids management facilities to allow for the production of biosolids with Class A pathogen reduction. Options for the production of Class A biosolids are described in the following section.

Options for the Production of Class A Biosolids

The selection of the Class A treatment process must consider, as a minimum, the disposal option(s) available to PCWMD, and the markets for the various Class A products that could be produced. For example, composting may not be a viable option for treatment to Class A standards if the markets for a compost product are not robust enough to provide a reliable means of solids disposal. The determination of the most cost-effective and reliable combination of Class A treatment option and product market requires a thorough study considering economics, market reliability, treatment reliability and public acceptance. The following paragraphs provide examples of some broad categories of Class A treatment technologies together with the Class A product market they will address.

Class A process and Biosolids Enrichment – Example Process: BER (Biosolids Enrichment & Recycling) Systems

The Biosolids Enrichment Recycling (BER) process converts wastewater biosolids to a Class A, phosphate-rich, organic-based fertilizer of exceptional quality. The fertilizer contains nutrient levels five to ten times higher than intrinsically found in untreated sludge. This process is designed to produce a product that is not only compatible with agricultural land application, but is marketable as fertilizer product.

According to BER Systems, Inc. it has developed a continuous-flow process, which sterilizes, stabilizes and deodorizes the biosolids mass produced during wastewater treatment, converting the biosolids to an exceptional-quality fertilizer, which is ready-for-market eliminating the need for digestion and disposal.

The BER process consists of a proprietary chemical pasteurization and nutrification technology utilizing agricultural grade chemicals to sterilize, stabilize, deodorize, and add value in the form of macro-plant nutrients.

A Supervisory Control and Data Acquisition (SCADA) system manages and automates the BER process and ensures the production of a Class A, exceptional quality fertilizer. The BER Process is recognized as a PFRP (Process for the Further Reduction of Pathogens).

The BER Process components can be housed in a single building, where the biosolids enter the building as a liquid containing as low as 0.4 percent total suspended solids (TSS), and leave as a granular, free-flowing, 95 percent dry fertilizer product, in bulk bags or 50 lb retail bags.

Online monitoring through SCADA meets all EPA requirements providing for continuous reporting of the entire process, assuring production of a Class A biosolids and beyond, to an "exceptional quality" fertilizer. The SCADA system also assures quality control of the fertilizer produced.

Thermal Hydrolysis – Example Process: Cambi

A patented thermal hydrolysis process developed in Norway in 1990-95 is called the Cambi Process. Cambi states, in this process, sludge is processed under high pressure and temperature (133 to 200°C). The organic components in the sludge dissolve in water in the same way as when you boil meat, fish, etc. Cell structures in the sludge break open under the temperature and pressure used and, as a result, energy-rich compounds from the cells are then dissolved. In addition, the sludge becomes fully sterilized so the final product is disinfected. This process is reported to achieve higher volatile solids reduction and also allows for easier dewatering of the biosolids.

Flash Drying

Flash drying involves processing sewage sludge in a cage mill or by an atomized suspension technique in the presence of hot gases. The process is based on exposing fine sewage sludge particles to turbulent hot gases long enough to accomplish mass transfer of moisture from the sludge to the gases. The operating temperature varies from 650ºC to 760ºC; the thermal energy requirement could vary from 450 to 1,000 kwh/ton of moisture removed. It is possible to achieve 90 to 98 percent solids content in this operation. With the retention time, temperature and solids content of the product qualifies for Class A pathogen reduction. However, for these processes most states mandate air quality permits.

Thermophilic Anaerobic Digestion

Anaerobic digestion is one of the most widely used processes for the stabilization of the primary and secondary sludges generated in the municipal wastewater treatment plants. The majority of the anaerobic digesters currently in use are operating in the mesophilic temperature range, i.e. from 35ºC to 40ºC during which the volatile compounds are converted by microbes into methane gas.

Anaerobic digestion also occurs at higher temperature range, named thermophilic range, from 45ºC to 65ºC, by the action of different group of microbes. This is being studied because of its superior ability to disinfect biosolids to meet Class A standard. The disadvantages of this process are higher energy requirements for heating, poor process stability, increased odor of the digested biosolids, and lower quality supernatant (filtrate/centrate). In the past, thermophilic digestion was also observed to be less stable than mesophilic digestion; however, more recently, better understanding of the thermophilic process and its biology has resulted in operating thermophilic digestion facilities that are equally as stable as mesophilic operations. The potential advantages of thermophilic anaerobic digestion over mesophilic anaerobic digestion are increased stabilization of sludge and methane production rates, and improvements in the sludge dewatering properties.

Pathogen reduction in anaerobic digesters is dependent on a time/temperature regime, higher temperature requiring shorter digestion period. Studies have shown that thermophilic digestion by itself achieves about two orders of magnitude higher pathogenic bacteria reduction than mesophilic digestion, and is good candidate for meeting the pathogenic bacteria levels required for Class A biosolids. However, to achieve Class A status in terms of the Part 503 regulations, the process must include a batch time-temperature step that holds all particles of sludge at the elevated temperature for the requisite period of time as dictated by the Part 503 rule. This can be achieved in tanks that are separate from the digestion tanks, or can be achieved by a strict feed/withdrawal regime in the operating digesters.

To improve the odor characteristics of the digested solids stability and performance of the thermophilic digesters, a two-stage digestion system with thermophilic first stage and a mesophilic second stage may be used. A fast start-up method produces a more robust thermophilic culture that is relatively tolerant to temperature fluctuations. Multiple stage digestion reduces the potential for short-circuiting. If the second stage reactor is mesophilic, the product is of a higher quality in terms of odor and supernatant.

Summary

During the late 1990s, a few counties in California passed restrictive ordinances banning the land application of anything but Class A or B biosolids. In October 1999, Kern County adopted an ordinance that banned Class B biosolids beginning January 1, 2003. A number of adjacent counties, including King and Fresno, adopted ordinances banning the use of Class B biosolids. In June 2001, the Riverside County Health Officer increased the setback requirement from residences for Class B biosolids application from 500 feet to 2,640 feet based on concern over potential health impacts. This reduced the available permitted land from 9,500 acres to 900 acres, effectively eliminating any significant Class B biosolids application in Southern California. In San Bernardino County the permitting procedures effectively banned any biosolids application. These incidences forced Los Angeles to begin their effort to achieve Class A status for its biosolids.

The foregoing demonstrates the political/social environment for biosolids in our neighboring State, which is frequently a leading indicator of future national trends. In addition, in northern Pima County, agricultural areas are rapidly transformed into housing developments. In the future, as the need for urban land increases, and the farmlands are converted to residential areas, land application sites become increasingly scarce. As far as Pima County's biosolids land application program is concerned, most of the available farmlands for biosolids application are in Pinal County at distances greater than 25 miles from the Regional Biosolids facility. Land application of biosolids is most cost effective if the available farmlands are in the vicinity of the biosolids processing facility to minimize hauling costs.

For an effective biosolids management program, PCWMD should explore and plan for establishing Class A biosolids production facilities. It should also diversify land application program to minetailings in addition to agricultural lands. The Industrial Wastewater Ordinance of Pima County has been very effective in controlling the heavy metal pollutants in the industrial wastewater tributary to Pima County's sewerage system. As a result, the heavy metal pollutants in PCWMD's biosolids have been lower than the limits specified for the exceptional quality biosolids. In addition to this, if the biosolids undergo Class A pathogen reduction process in the Regional Biosolids Facility, the resulting exceptional quality biosolids will have a better value than the Class B product currently being generated at that facility, and the reuse of the Class A product will have very few restrictions. If the final product is dried or pelletized, handling, storage and reuse of biosolids will be very efficient.

Given the transfer of solids from Roger Road WWTP to Ina Road WPCF is planned, and recognizing the capital investment to modify Ina Road WPCF solids treatment to accommodate Roger Road WWTP solids is significant, it is recommended PCWMD consider moving to Class A treatment process to operate a higher rate to accommodate Roger Road WWTP solids at the existing Ina Road WPCF. In this way, PCWMD will achieve the highest value for their capital investment.

Finally, it is recommended that prior to implementing any solids treatment modifications and improvements to either Roger Road WWTP or Ina Road WPCF, a thorough evaluation of alternatives be conducted. This evaluation should focus on determining the most cost-effective system to address the following issues:

- Provide adequate biosolids treatment capacity.
- Provide Class A biosolids that are marketable in Southern Arizona.
- Provide reliability in terms of the robustness of the mechanical and biological processes.
- Improve odor control in and around both Roger Road WWTP, Ina Road WPCF, and the Regional Biosolids Management Facility.
- Provide flexibility in terms of the ability to modify the process to address changing markets for biosolids products.
- Provide options for biosolids handling facilities for outlying facilities.

Conclusions and Recommendations

Based on the discussion in this chapter, PCWMD should:

- Perform a comprehensive biosolids processing study.
- Rehabilitate the existing biosolids facility at Ina Road WPCF.
- Relocate the biosolids handling at Roger Road WWTP to the Ina Road WPCF and centralize the biosolids processing at the Ina Road WPCF.
- Upgrade the treatment process for biosolids to produce Class A pathogen-free biosolids.
- Develop an increased diversity of biosolids disposal systems, including (at a minimum) land application and mine tailings.
- Participate in the National Biosolids Partnership Environmental Management System (best practices) program.