Biosolids management trends: technologies, regulations, and public relations.

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Abstract: Biosolids reuse has been practiced around the world for several decades. In the past, it has generally been acceptable to the public, but current experience is dramatically different. As a result of various social, demographic and political changes, there has been a noticeable increase in public concern in regard to biosolids re-use. Concerns include the safety of crops grown on farms using biosolids as an input, the long-term health of those soils with respect to the accumulation of heavy metals and other contaminants that may be present in biosolids, potential contamination of groundwater, odour generation, and airborne transmissions of viruses. As a result of these concerns there has been a review of regulations in many jurisdictions. There are many challenges that face the biosolids industry. The paper discusses biosolids management trends in regard to technologies, regulations, public and media relations, and the associated challenges that generators face. It will present strategies that should be considered in preparation for the future, if we are to be sustainable.

Keywords: Biosolids, public, concern, regulations, sustainability, technologies

Background

Biosolids reuse has been an on-going practice in North America, Europe and around the world for several decades. Currently, a major portion of biosolids produced in North America is beneficially used, the bulk of which is application to agricultural land (See Figure 1).

While it is true that in the past, beneficial use, particularly land application, has generally been acceptable to the public, this is changing. As a result of a variety of social, demographic and political changes, there has been a notable increase in public opposition to biosolids reuse. Public reaction varies from protests at public information meetings and picketing of land application sites, to calls for outright bans on land application of biosolids, in any form, on agricultural land. (Nazareth et al, 2003).

Figure 1 How Biosolids Are Used in Various North American Jurisdictions

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This is of major concern because vast quantities of biosolids residuals are produced at wastewater treatment plants, especially in heavily populated urban areas, and there is an on-going need to reuse or dispose of these residuals in a responsible and sustainable manner.

Public concerns include the safety of crops grown on farms using biosolids as an input, the long-term health of those soils with respect to the accumulation of heavy metals and other contaminants that may be present in biosolids, potential contamination of groundwater, odour generation, and airborne transmissions of viruses.

The paper reviews factors which are expected to affect the production, treatment, handling and end use/disposal of biosolids in the future, and discusses trends that have begun to shape biosolids management and the strategies that the industry should be developing to create at atmosphere of success in the long-term.

**THE NEED FOR CHANGE**

Public concerns have prompted a review of regulations in many jurisdictions. In response, municipalities (the principal generators of biosolids) need to make changes to the way that they manage biosolids. In essence the industry has changed more rapidly in the past ten years than it has in the previous fifty. Application of unstabilized biosolids is disappearing, as it should, and many municipalities have moved to a dewatered cake as opposed to a liquid product. Some municipalities are implementing or reviewing Class A technologies to produce a product (near pathogen-free) that is more acceptable to the public, with more options for end-use, providing diversity in their biosolids programs.

The wastewater industry has been responding with advances in technologies, dramatic changes in regulatory approaches and additional research. However, implementation of technologies that process biosolids further and produce a more stable less odourous product are not necessarily perceived by the public to be the “safe and correct” solution.

**Future biosolids management approaches cannot just be technically sound, but must also be sustainable, feasible and acceptable to the public.**

**Figure 2 Essentials of Successful Biosolids Programs**

Municipalities/utilities, as generators of these residuals, are now facing a public that has become more aware of environmental issues and is more willing to be vocal about their concerns. There is an emerging realization in the industry that there is a major need to engage the public in open communication that is partly educational and partly participatory, but this is not a global point of view.

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**Figure 2 illustrates the essentials of a successful biosolids management program. These essentials are not one-dimensional considerations as they incorporate more than one factor, and are interdependent, as described below:**

**Sustainability** — means that the program for biosolids management takes a long-term view of protecting and preserving the environment. In essence, it speaks to the need to preserve the environment for future generations. Sustainability encompasses economic prosperity, community well-being and environmental integrity for current and future generations (Greater Vancouver Regional District, September 2006).
Feasibility – includes not only technical and physical feasibility (availability of land, transport routes, etc.) but also economic viability and the ability of the generator to maintain the program in operation.

Acceptability – public input to projects that impact, or are perceived to impact the environment, is generally a legislated requirement in the form of environmental assessments or environmental impact statements. Merely fulfilling this legal requirement does not ensure public acceptance. Public acceptability can only be attained with public education, achieved through on-going, open and two-way communication. The public needs to know that the program can achieve its goals and that it is as safe as it can be now, and in the future.

For municipal biosolids management programs to be successful in the long run, all three elements must be present; success will not be achieved if any one of the three is missing.

EMERGING IMPACT FACTORS

While the industry has made great strides in advancing technology and moving regulations forward, public skepticism has significantly impacted both Class B (biosolids that have been subject to partial pathogen reduction technologies) land application programs and Class A production and distribution programs. Several programs have been threatened or stopped due to increased costs associated with defending the concepts of biosolids recycling. Others have been stopped outright due to lack of public acceptance. (Beecher, 1999)

Although public skepticism is a factor that is impacting and will continue to impact biosolids management, there are other factors that will have more direct impacts. The following summarizes these impact factors.

Growth.

As population increases, especially in and around urban areas, flows and loads to wastewater treatment plants will increase, with a corresponding increase in the mass of biosolids produced. This will be accompanied by an increase in capital needs, proportionately higher operating costs, the need for new markets or additional land for application, and larger facilities for storage, particularly in colder climates.

More Stringent Wastewater Effluent Discharge Limits.

The general regulatory trend in most jurisdictions is the creation of stricter effluent discharge limits. In Canada, the Canadian Council of Ministers of the Environment is developing a nationwide strategy for municipal wastewater effluents, which will set a timeframe for achieving secondary treatment levels for all municipalities across the country. This, together with higher required removals of pollutants (BOD, suspended solids), will have a significant impact on biosolids volumes and quality (including settleability and dewaterability).

In British Columbia, the GVRD is expecting that the projected population growth within its boundaries, coupled with the need to move to secondary treatment at some of the five plants under its control, will double the biosolids production over the next twenty-five years (GVRD, 2005). The estimated production in 2005 was approximately 30,000 dry tonnes/year, and this is expected to rise to about 60,000 dry tones per year. Assuming an average operating cost per tonne of CDN$350, this increase in biosolids quantity could represent an additional annual cost over CDN$10,000,000, not accounting for the need for more space for construction of new/larger facilities, and more land for application.

Nutrient Control in Effluents.

Phosphorus is recognized as one of the nutrients that has contributed to the degradation of water quality in many receiving waters. Consequently phosphorus limits in liquid effluent discharges continue to decrease. The result is that the phosphorus content in biosolids will increase. This will affect the nutrient ratio in biosolids products, making them less attractive to farmers as a result of the increased phosphorus content and lower nitrogen-phosphorus ratio.

The City of Winnipeg will be required to implement nutrient removal at its three wastewater treatment plants. This will increase the phosphorus content in the biosolids and when coupled to impending phosphorus application limits will result in a ten-fold increase in its land bank, which could make land application unworkable.
Contaminants of Concern
Pharmaceutical residues, endocrine disruptors, and HRT (hormone replacement therapy) drugs are already being detected in the environment, in some cases, immediately downstream of wastewater treatment plants outfalls. Contaminants are also finding their way into the biosolids produced by wastewater treatment plants. Society and industry keep relying on the assumption that wastewater treatment plants are a solution for whatever is flushed down the toilets or discarded into our drains. In addition to the search for technologies that may be able to remove potentially harmful contaminants, there is a need for better control at source coupled to a public education initiative.

Energy Considerations and Global Climate Change
While it appears that governments are moving at a snail’s pace in endeavours to mitigate the global warming, or even to agree that the phenomenon is linked to greenhouse gases, over the next ten to fifteen years this is expected to change. Biosolids management programs will be affected as consideration of carbon credits will need to be taken into account in evaluating process options.

With energy conservation and the search for renewable energy sources becoming popular, biosolids management can be seen as a potential contributor to the overall solution. Better recovery and more complete use of methane from anaerobic digesters, use of biosolids (e.g., pellets) as a fuel source and the conversion of biosolids to fuel, would begin to be more attractive from the regulatory and public perception points of view, as these initiatives could be seen as having a two-fold benefit.

REGULATIONS: POTENTIAL DIRECTIONS
Regulatory control of biosolids is changing around the world. In the developing world it is largely due to public outcry. In a survey conducted for NEBRA, 65% of respondents identified “public perception, misunderstanding, confidence, disinformation, NIMBYs, inaccurate perception, uncertainty, fear, distrust, acceptance, negative attitudes as a major obstacle to biosolids recycling in New England (Center for Environmental Communications, 1999). Twenty-six percent identified ignorance and education, and the same percentage indicated regulations (over-regulation, insufficient regulation, unsupportive state/federal agencies, timid agencies, distrust of regulators) as the next two obstacles, followed by odour issues (24%).

It is clear that regulators need to become part of the solution not just by creating rules; they should strive for regulations that are science-based, and be willing to confidently stand by these regulations in front of all stakeholders. This is essential if the biosolids industry is to improve public perception in regard to its reuse.

Regulations that are based on sustainable action have more chance of success, provided that there is sufficient research for justification, and adequate on-going research to verify that the findings remain valid. Some of the anticipated regulatory trends include:

- Consideration that biosolids when properly treated, content-controlled and safely handled, are a resource not a waste.
- Nutrient management approaches that match nutrient application to crop uptake will be seen by the public as sustainable, provided there is sufficient control of contaminants of concern. In many jurisdictions where this is not yet mandated, the concept of nutrient management plans is already recognized as a farming best practice.
- Creation of a regulatory approach at the highest level of government to control the introduction of contaminants of concern into the environment. This could mean that the use of some substances (products) will need to be curtailed or prohibited. Eventually, we will need a holistic review of new products, on the basis of benefit versus cost to the environment and potential secondary health effects, if these contaminants were to accumulate in the environment. Source control will also need to move higher on the agenda of both the regulators and the municipalities that operate sewerage systems.
- Legislators will eventually need to come to grips with an approach to global warming, controlling emissions and the concept of carbon credits. This will allow generators of biosolids to take into account carbon emissions.
credits as they evaluate biosolids management alternatives, thus enhancing the chances of selecting an energy recovery option as the preferred solution, which may not be the case if reliance was placed on economics alone. Forward-thinking municipalities will begin to look afresh at maximizing the energy recovery (or conservation) potential from their biosolids facilities.

- Consistency in regulatory approaches will help to give the public a degree of confidence. Throughout Canada, biosolids use or disposal is regulated by provincial governments, though the provisions of CEPA (Canadian Environmental Protection Act a Federal regulation) affect the potential for management of biosolids. (Lewis, 2006).
- As a result, there are noticeable differences in the way that biosolids are managed from province to province. The existence of multiple approaches in biosolids regulations is seen as the cause for much confusion and a potential source of public concern. There is growing support for a national, unified approach to biosolids management, including regulations. (Leblanc, 2005).

Finally, to support the regulations and practices that pertain to biosolids management, authorities must be involved in financing and undertaking of research to support these efforts.

TECHNOLOGY TRENDS

Current Practice

With public concerns mounting and the regulatory framework becoming more onerous, biosolids management programs are already undergoing change. The industry has started moving from liquid products that are partially stabilized (Class B) to dewatered products. Material that is lower in moisture content means lower transportation costs and smaller storage facilities. In Ontario, where spreading on frozen or snow-covered ground is prohibited, there is a requirement for generators to provide a minimum of 240 days of storage or a combination of storage and other measures that will provide the ability to deal with 240 days of production without the need to land apply. Similar restrictions are being considered in Manitoba.

The public is concerned over the potential for crop and source-water contamination, and as a result there is a growing trend to move to a higher quality of product, that can be sold as fertilizer or as a soil amendment product. Technologies such as composting and drying (including pelletizing) are being implemented. Composting has proven to be very successful in British Columbia in communities such as Penticton and Kelowna. Pelletizing has been successfully used in Milwaukee (where a product called Milorganite™ has been successfully produced and marketed for several decades). Systems such as N-Viro™ which incorporate alkaline stabilization and drying have also begun to gain a foothold.

Odour is one of the major handicaps associated with biosolids processing, handling and end use/disposal. Dry products have advantages over dewatered biosolids, as they tend to be relatively odour free and not likely to deteriorate over time if kept dry. Much research is being done on mechanisms which contribute to odour generation, and methods to prevent odour-generation. Likely these will continue until effective odour management practices and odour treatment technologies are identified.

Promising Technologies

Research is on-going on many emerging technologies that are identified as innovative or embryonic (EPA, 2006). Some of the promising innovative ones are described below.

Volume Reducing Technologies: There are various technologies, which have the ability to reduce the overall mass of biosolids residuals, and offer significant savings in handling, processing and transporting end products, including:

- MicroSludge™ - a process that uses chemical treatment and high pressure to lyse cells in thickened waste activated sludge prior to anaerobic digestion. Higher volatile solids destruction and higher gas production is achieved, as well as a 30 – 50% reduction in final product volume.
• Ultrasonic cell lysis of thickened waste activated sludge prior to anaerobic digestion with similar results as the above process.
• Thermal hydrolysis (CAMBI™ process) produces cell lysis through temperature and pressure.
• The Cannibal™ solids reduction process that uses a facultative bioreactor which destroys aerobes. The mixed liquor from the bioreactor is returned to the main treatment process where the facultative bacteria are broken down.

Liquid stabilization technologies: including TPAnD (Temperature Phased Anaerobic Digestion) and two-phase acid-gas digestion produce Class A biosolids, with higher volatile solids destruction.

Thickening and dewatering technologies: Flotation thickening applied to digesting sludge using digester gas has been in use full-scale and produces a 6 – 10% solids concentration before being returned to the digester. This increases volatile solids destruction and reduces the final solids volume by some 34%. Membrane thickeners are being successfully used in aerobic digestion applications. Inclined screw presses can dewater a mixture of primary and secondary sludge from a 1 – 2% solids concentration to 20 – 25% after flocculation. The slower moving parts means less wear and tear on the equipment.

Thermal conversion: Minergy GlassPack™ technology is a vitrification process that converts biosolids to a glass aggregate that can be used for sand-blasting, roofing shingle granules and asphalt paving. A 12 dry-ton per say facility is operational in Wisconsin. The process has significant air emission improvement over traditional incinerator type techniques and there is no ash residue to be disposed of.

Additional research is needed for processes that improve the nutrient make-up of biosolids products, either through the removal and recovery of phosphorus or the addition of nitrogen.

Public Relations
Any interaction with the public is public relations and good public relations starts with communication. Some of the best reasons for communicating with the public (Public Communications, WEF, 2002) include:
• Building up community support and diminishing opposition,
• Helping people to understand the value of what the municipality does for its citizens,
• Preparing the public for innovation, changes in regulations, rate increases, and,
• Strengthening the municipality’s image as a good neighbour who is providing a vital service.

According to the Best Practice for Communication and Public Consultation for Biosolids Management (Infraguide 2004), the principles of a municipal communication and public consultation programs should be founded on the principles of trust, quality of information, communication, fairness, and commitment.

In summary for a public relations campaign to be successful, it needs to be built on a basis of trust and mutual respect. A municipality’s communication plan should have the following components:
• An on-going communications strategy, where there is regularly scheduled opportunities for open dialogue with the affected communities.
• Sharing of information so that the public can understand issues and make informed decisions.
• A media relations campaign to build relationships with correspondents in the print, radio and television media.
• A means of disseminating information pertaining to the biosolids management program. This may include fact sheets, bulletin boards at municipal offices/libraries/community halls, use of the corporate web site and inserts in water/sewer bills. Results of testing of the biosolids end product and reporting on other compliance issues should be available to the public.
• Scheduled open houses/visits to treatment plants, biosolids facilities and land application sites.

In addition, there should be a process to actively engage the public in consultation whenever the municipality is embarking on changes to the program, implementation of new facilities, or when responding to changing regulations.
Conclusions

For biosolids management programs to be successful, regulators, generators, technology developers and the public must all be involved. The industry must as a whole consider the broader context of preserving the environment and protecting public health.

Biosolids programs will not be successful solely because technologies work, or solely because solutions are affordable or if the sole reason for adopting an alternative is because it is acceptable to the public. Programs will be successful because they are sustainable within the community and environment, because the technology is feasible and because the public has accepted the solution after knowledgeably participating in the decision-making process.

Regulations need to be created that will help to keep contaminants out of wastewater flows, rather than trying to treat for such substances at the wastewater treatment plants. More attention needs to be given to volume reduction and to energy recovery potential with biosolids processes.

For successful programs, the solutions proposed must be sustainable and feasible, and the public must be engaged in an on-going, open dialogue that is based on mutual trust and respect.

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