The CalgroTM Program and Calgary Biosolids Management Sustainability

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Abstract: Calgary is the largest city in Alberta, Canada, with a 2006 population exceeding 1,000,000. The City of Calgary operates two municipal wastewater treatment plants, Bonnybrook and Fish Creek, to provide treatment to Calgary wastewater prior to its discharge to the Bow River. Both primary and secondary sludges are produced at the treatment plants. After undergoing treatment with the anaerobic digestion process, digested sludges are regularly pumped to the Shepard Sludge Lagoons for storage and gravity settling. The Shepard supernatant is continuously returned to the Bonnybrook Plant as a recycle flow. The CalgroTM Program was started in 1983, and is a unique "Biosolids to Land" program using subsurface injection. The Calgro Program strictly follows Alberta Environment’s Biosolids Application Guidelines. The Calgro staff works closely with the participating land owners/farmers to obtain available fields, to select the suitable crops, to monitor biosolids and soil characteristics, and to provide guidance and assistance to the participating farmers. There is no charge to the farmers. For over 23 years, the CalgroTM Program has continued to be cost-effective, well-run, well-monitored, and well-received by Calgary farmers. With its cost effectiveness, viability, and environmental friendliness, the CalgroTM Program provides long-term sustainability to Calgary’s wastewater biosolids management.

Keywords: Biosolids; CalgroTM Program; Fertilizer; Subsurface Injection; Sustainability

INTRODUCTION

Calgary is the largest city in Alberta, Canada, with a 2006 population exceeding 1,000,000. The City of Calgary owns and operates two municipal wastewater treatment plants, Bonnybrook and Fish Creek, to provide treatment to Calgary wastewater prior to its discharge to the Bow River (Exhibit 1). The Bonnybrook Plant is a biological nutrient removal tertiary treatment plant with a design capacity of 500 ML/d (Exhibit 2). The Fish Creek Plant is an oxygen activated sludge treatment plant with a design capacity of 72 ML/d (Exhibit 3). Both primary and secondary sludges are produced at the two treatment plants. After undergoing adequate treatment with the anaerobic digestion process, digested sludges are regularly pumped to the off-site Shepard Sludge Lagoons for storage and gravity settling to separate sludge solids from the clear supernatant. The Shepard supernatant is continuously returned to the Bonnybrook Plant as a recycle flow. Since 1973, the thickened lagoon sludge, or biosolids, has been recycled by surface spreading on agricultural lands for the production of alfalfa, canola, oats, barleys and wheat. Biosolids are a natural organic fertilizer/soil conditioner that contains all the necessary primary, secondary and micronutrients required for plant growth. When applied to agricultural lands, biosolids also improve the tilth and water-holding capacity of the soil, and substantially increase crop yields.

In 1983, the CalgroTM Program was started as a joint initiative between The City of Calgary and the Province of Alberta. The CalgroTM Program is a unique “Biosolids to Land” program using subsurface injection. The Program follows Alberta Environment’s Biosolids Application Guidelines. The Calgro staff works closely with the participating land owners/farmers to obtain available fields, to select the suitable crops, to monitor biosolids and soil characteristics, and to provide guidance and assistance to the participating farmers. There is no charge to the farmers.
Exhibit 1 Calgary and the Bow River

Exhibit 2 Bonnybrook Wastewater Treatment Plant (500 ML/d)
CALGARY BIOSOLIDS PRODUCTION

At the Calgary WWTPs, the combined primary sludge and secondary sludge undergoes adequate stabilization by the mesophilic anaerobic digestion process. The digested sludge is regularly pumped to the off-site Shepard Sludge Lagoons (Exhibit 4).

In the Shepard Sludge Lagoons, the digested sludge is thickened by gravity settling from 2.5% to 8% Total Solids (TS) concentrations (Exhibit 5). During the summer months, from May - October, the thickened lagoon sludge (Calgary biosolids) is recycled by the Calgro™ Program to agricultural lands for the production of alfalfa, canola, oats, barley and wheat.

CALGARY BIOSOLIDS RECYCLING

Alberta Environment’s Guidelines for Land Application of Biosolids

In Alberta, land application of biosolids is authorized by Alberta Environment. Alberta Environment has developed Guidelines, which provide various criteria to maximize the benefits associated with biosolids land application while minimizing the potential risks.

Prior to applying biosolids to land, a biosolids-producing facility must obtain a Letter of Permission from Alberta Environment covering each parcel of land considered. This Letter of Permission specifies the conditions that must be adhered to in the application of biosolids. The allowable biosolids application rate is based on:
In addition to specifying the allowable application rates, the Guidelines also contain criteria pertaining to setbacks from specified features, method of biosolids application, permissible crops, suitable times of year for applications, and return periods for biosolids reapplication.
Land Application of Biosolids using Surface Spreading

The City of Calgary’s biosolids application program is carried out in accordance with Alberta Environment’s Guidelines for Biosolids Application. These Guidelines were established by Alberta Environment after extensive studies, which included, among experimental projects in other parts of the province, field experiments at the Shepard Sludge Lagoons dating back to 1975.

From 1975 until 1982, land application of Calgary biosolids was carried out by surface spreading on agricultural lands in the vicinity of the Shepard Sludge Lagoons through annual contracts with private contractors. The biosolids was pumped from Summer Cell 5 by the contractor into tanker trucks, which hauled and spread biosolids on farmland. Various farmers in the area were contacted to obtain land for biosolids application. Land nearest to the Lagoons, which was suitable for biosolids application, was given preference. There was no charge to the participating farmers.

Land Application of Biosolids with the Calgro™ Program

The Calgro™ Program Calgro™ is the official trade name used by The City of Calgary to describe Calgary’s highly successful “Biosolids to Land” program using subsurface injection. In 1983, the Calgro™ Program was started as a joint initiative between The City of Calgary and the Province of Alberta. Subsurface injection of biosolids is more effective, safer and more environmentally friendly than biosolids surface spreading. Subsurface injection almost completely eliminates odour, flies and surface runoff, as well as all potential concerns associated with surface spreading. Calgro staff also carefully monitors setbacks from roads, waterways and steep slopes to further ensure there is no runoff from treated fields.

Subsurface Injection of Calgary Biosolids

There is a strong interest in the Calgro™ Program from area farmers. Those who want to take part in the Program are mailed an application form in the fall. The Calgro™ Program Specialist and Calgro’s field foremen, who are familiar with local crops, soils and fertilizer practices, review every application. Fields are selected on the basis of road access, size of field, topography, intended crops, and existence of physical barriers such as sloughs. The final step in the field selection process is obtaining Alberta Environment’s approval. Although The City operates under a general approval issued by Alberta Environment, fields require individual authorization for the application of biosolids. Individual fields selected by the Calgro staff are submitted to Alberta Environment for approval. This multi-step selection approach assures that biosolids application will take place only on lands that are suitable and can benefit from this environmentally-sound recycling effort.

Calgro’s application operation uses the most advanced technology to achieve the maximum benefit from the nutrient-rich biosolids. Biosolids are pumped into eight tanker trucks at the Shepard Lagoons. The tanker trucks then deliver biosolids to one of the two field storage tanks (Exhibit 6). Four application vehicles, called Terra-Gators, load the biosolids from the field storage tanks, and precisely inject the product two to five centimetres beneath the soil surface (Exhibit 7). Subsurface injection almost completely eliminates odours and surface runoff, while maximizing the available nutrients by accurately delivering the product to the zone where plant roots have easy access.

Exhibit 6 Calgro Operation at an Application Site
In each Terra-Gator, the use of a Global Positioning Guidance System provides the exact location of where the product is being applied, thus ensuring consistent application and coverage. Farmers especially appreciate this part of the operation as the nutrients are uniformly distributed without missed areas, allowing crops to grow evenly. To reduce the problem of soil compaction, all Terra-Gators are equipped with high flotation tires. The staging operation also takes place in one location, as close to the field entrance as possible, to minimize field traffic and soil compaction.

Environmental Monitoring An extensive monitoring program is in place to ensure that the Calgro™ Program is carried out in an environmentally-safe manner. Monitoring is conducted under the Guidelines established by Alberta Environment. Biosolids are not permitted to be applied to root crops, vegetable or fruit crops, tobacco crops, or dairy-pasture lands under these Provincial Guidelines. In addition, direct grazing of lands treated with biosolids is not recommended for three years following the application. Biosolids can only be applied to forages, oilseed crops, small grains, commercial sod, and trees. Calgro staff also observes all minimum setback distances from wells and other bodies of water.

Once a field has been selected, biosolids are sampled prior to the application to determine the Total Solids concentration. Soil samples are taken from the selected fields, which must have a pH of 6.5 or higher. This information is used to determine the correct nutrient rates for the particular field. Fields previously treated with biosolids do not receive another application until three years has passed, and the available nitrogen levels in the top 150 centimetres of soil have declined to less than 250 kilograms per hectare. During Calgro’s operating season, the Bonnybrook Laboratory staff regularly analyzes the biosolids for nutrients and metal levels. The lab results consistently show that all biosolids applications are well within the strict Alberta Environment Guidelines.

THE CALGRO™ PROGRAM & BIOSOLIDS MANAGEMENT SUSTAINABILITY

Calgary biosolids are in demand by area farmers because of their soil-enhancing properties and high nutrient values. Fertilizer is a major expense in growing crops, and farmers’ fields typically receive sufficient nutrients for a three-year worth of crops from one Calgro application. These benefits, supplied at no cost to the farmers, provide the key to achieving long-term interest and relationship with Calgary farmers. The City and its citizens
also benefit from the environmentally-friendly recycling program. With biosolids safely recycled as a fertilizer/soil conditioner, The City does not have to put this beneficial product in a landfill or an incinerator, thus reducing the demand on City landfills and protecting air quality. At $80 - $120 per 1000 kg of biosolids, Calgary biosolids recycling via the Calgro™ Program is also much more economical than the other alternatives of biosolids disposal.

Each year, the Calgro™ Program recycles about 20 million kilograms, or 9500 tanker truck loads, of biosolids for agricultural production, with the authorization of Alberta Environment. This major recycling activity requires an annual supply of approximately 2000 hectares (4940 acres) of farmland (Exhibit 8).

Exhibit 8 Recycling of Calgary Biosolids to Agricultural Lands

CONCLUSIONS

Since its commissioning in 1983, over 23 years of steady operation, the Calgro™ Program continues to provide long-term sustainability to Calgary’s wastewater biosolids management. Recycling of Calgary biosolids for agricultural production, using subsurface injection, is viable, successful and much more economical than the other methods of biosolids disposal such as mechanical dewatering, incineration or landfilling.

Participation in the Calgro™ Program offers Calgary farmers the potential for increased crop yields and reduced commercial fertilizer usage. There is no charge to the participating farmers. In addition, the farmers receive close cooperation, technical guidance and assistance from the Calgro staff. Due to its environmental friendliness, cost effectiveness and proven success, the Calgro™ Program has received many awards and accolades, and has been included in The City of Calgary’s long-range strategic plans.