California Integrated Waste Management Board
Session Summary:
Emerging Technology Forum
April 17-18, 2006
Breakout Session 1C. The European and Japanese Experience

Brief summary of presentation by Rick Diederich prepared by CIWMB staff

Rick Diederich is President and CEO of ILS (Innovative Logistics Solutions, Inc) – Partners. ILS-Partners is a California-based company that uses ultra-high temperature gasification technology developed and commercialized by Pyromex A.G., a Swiss Corporation. Mr. Diederich's presentation was entitled, "Pyromex Ultra-High Temperature Gasification Implementation in Germany."

Mr. Diederich began by describing the project, which was to develop a commercial scale Pyromex Waste-to-Energy facility to gasify wastewater sludge in Emmerich, Germany. He said the facility was permitted by the German Ministry of the Environment in late 1999 and operated for over three years, meeting all environmental and emission regulations. He added the equipment was eventually moved to a wastewater treatment facility in Neustadt, Germany for commercial operation.

Mr. Diederich discussed some of the permitting and regulatory considerations for the project, including no air emissions from the Pyromex gasification process being allowed. He said that the EU differentiates gasification from incineration and, while permitting is stringent, it is acceptant of scientifically advanced technology.

Mr. Diederich then explained what makes Pyromex gasification unique, including operational temperatures between 1200 and 1700 degrees Centigrade; thermal decomposition in an oxygen free environment; minimal amount of inert, non-leachable residue; no ash, no char, no tar, no emissions and no stack; and the most efficient and cost effective means of converting waste to energy.

He said that Pyromex gasification technology was part of a two-year European study that was funded by the Energy, Environment and Sustainable Development Committee in Brussels, which found Pyromex gasification met all environmental standards and is well suited for waste elimination and generation of clean energy from non-recyclable organic waste. He added that the study concluded that the technology has the potential to become a major contributor to the hydrogen economy.

Mr. Diederich said current German permitting allows a wide range of waste types to be accepted, including farming and animals waste, plastic waste, fly-ash from power plants, waste from car recycling, medical waste, and shredder waste. He discussed some of the current European activity taking place with Pyromex gasification, including a commercial scale industrial waste facility in Munich being fully permitted and under construction, and projects in the planning stage for different waste types such as hospital waste and auto shredder residue. He noted that the technology was introduced to the U.S. market 30 months ago and several projects are in the planning stage. He provided a list of regulatory challenges facing the technology, including the current California regulations considering gasification a form of incineration and waste elimination and energy generation being viewed as separate processes rather than complementary or compatible.

He concluded his presentation by saying that Pyromex A.G. has just been selected by the European Directorate of Research to participate in the Neptune Project to develop "New sustainable concepts and processes for optimization and updating municipal wastewater and sludge treatment."

Brief summary of presentation by Necy Sumait provided by CIWMB Staff

Necy Sumait is Vice President of Project Development for Arkenol, Inc. Arkenol is a technology and project development company that focuses on construction and operation of biorefineries that utilize concentrated acid hydrolysis technology to convert various forms of biomass into high-value chemicals and transportation fuels.

Ms. Sumait's presentation was entitled, "Biomass to Ethanol." She began by discussing Arkenol's experience with two pilot facilities. She said the first was in the City of Orange in California and was used to test equipment and feedstock, and operated for five years from 1992. The second is in Izumi, Japan and is located adjacent to an existing ethanol plant and has been in operation since 2002. She added that the Izumi biomass facility is a fully integrated, concentrated acid-hydrolysis system that uses waste wood chips as feedstock. She noted that sulfuric acid recovery is over 97 percent and tests were successful on lignin combustion and also on ethanol production by microorganisms developed by National Renewable Energy Laboratory. She said the Japanese Government uses the ethanol to test engine driveability and materials coupon tests.

Ms. Sumait said that siting and environmental impacts from Arkenol's process are minimal since feedstock is used up in the process and there is already a well established regulatory process to evaluate air emissions and controls. She added that process water is recycled so the wastewater discharge is primarily cooling water blow-down, which already has a well established regulatory process in place. She provided other examples where public health and safety issues are addressed by the Arkenol process, including no requirement for high pressure/temperature vessels and minimum fugitive dust from biomass handling.

Ms. Sumait then discussed Arkenol's permitting experience in California for a Sacramento ethanol project in the late 1990's. She said all of the regulatory approvals were obtained and the project was proposed to be constructed with a new power plant. She observed that what killed the project was it didn't meet the requirements for non-recourse project financing – growers were not considered financeable and the ethanol market was uncertain at the time.

Ms. Sumait identified some of the regulatory and siting hurdles in California to construction of conversion technologies (CT), including who will do CEQA compliance review and additional local permitting may be required if CTs are considered disposal facilities. She provided a list of actions to address the hurdles, including the use of memorandums of understanding among agencies to determine who leads review, scope of review, and how enforcement of permit conditions will be done; and the need to acknowledge the benefits of biomass to renewable fuels, such as monetizing the reduction benefits of green house gas emissions.

She provided a list of synergistic opportunities for siting Arkenol facilities, including using material recovery facility residuals by locating adjacent to a MRF and cogeneration opportunities by locating next to an existing power plant. She concluded her presentation by saying California can create change by creating the markets for biomass fuels and power, encouraging investments in production facilities, and establishing sound environmental policies (update rooted environmental biases).

Brief summary of presentation by Henrik Harmssen prepared by CIWMB Staff

Henrik Harmssen is a senior engineer at Waste Solutions Ltd in Dunedin, New Zealand, where he deals with design and construction of anaerobic treatment plants for a wide range of different waste streams in various countries.

Mr. Harmssen's presentation was entitled, "Anaerobic Digestion of Biological Wastes – the Agricultural Approach, Examples and Experiences." He began by describing the history of biogas production in Germany, which started in the 1950's with the digestion of manure. He described the development of lieing plug-flow digesters in the 1980's, which were later replaced years with the standing cylinder that had a double membrane that served as both a cover and gasholder. He added that a second tank and sometimes more tanks were added, which is now more or less part of the standard - the so called dual purpose tank - serving as storage for digested manure and as a gasholder. He noted that during the same timeframe, farmers began adding additional substrates (mostly sludgy wastes like the contents of fat separators and food processing wastes), which enhanced gas production. He added that during the same time, pioneers adapted this process to the digestion of separately collected organic fraction of municipal solid wastes. He said that one of the first plants for digestion of municipal biowaste in agriculture-derived type of plants is still working today after some renovation.

Mr. Harmssen said a new approach to energy production by anaerobic digestion in Germany evolved from a policy initiated by the labor-green government. He said energy crops, mostly corn, have become more a feedstock for biogas production. He observed that farmers have removed cows out of the following cycle: 1. animal feed production; 2. feeding the animals; 3. anaerobic digestion of the wastes; and 4. recirculation of the nutrients to the fields. He added that it is sometimes more economic to omit animals in this cycle and to feed the biogas plant directly. The harvest of animal feed (energy crops) is directly fed into the biogas plant. He said energy crops are digested in specialized biogas plants that are similar to biogas plants for manure, with the addition of special equipment, e.g., a better mixing technique, specialized feeding machinery, etc. He said for higher demands, a digester with a higher ratio height to diameter with a centrally located agitator is preferred.

Mr. Harmssen said the key to deciding which anaerobic digester system to use is dependent on the amount of available capacity. He noted where there is a large space, low cost, simple anaerobic digesters can be used that will produce a minimum rate of biogas (0.5 – 1 volume biogas per volume digester per day). Where there is less space, a more robust system that costs more can be used that will produce a low rate of biogas (1-3 volumes of biogas per volume digester per day), such as anaerobic baffled reactor systems (ABRs), covered in-ground anaerobic reactors (CIGARs), and continuous stirred tank reactors (CSTR digesters). Where there is very little space, a higher cost, highly engineered and compact systems can be used that will produce a high rate of biogas (3 – 10 volumes biogas per volume digester per day), such as upflow anaerobic sludge blanket reactors (UASB reactors) and contact type reactors.

Mr. Harmssen concluded his presentation by saying that anaerobic digestion is the keystone for energy efficient waste management. He added that synergistic effects in integrated waste management systems contribute to energy efficiency systems. He said the integration of agriculture with waste management is a cost-effective strategy; the utilization of the products and the operational experience with this kind of materials may contribute to a project's success. He ended by recommending that different wastes should be kept separate as much as possible, the waste to be treated must be well known, and the operator must have the control over the wastes. He said intelligent reactor technology can combine the advantages of high performance with low costs.