

Conference Report

Implementation of Anaerobic Sewage Treatment in the Middle East with a focus on Jordan and Egypt: A low-cost, low-energy alternative, March 13-15th, 2006 in Cairo Egypt

By Dr. Jim A. Field, University of Arizona

The workshop entitled, “Implementation of Anaerobic Sewage Treatment in the Middle East with a focus on Jordan and Egypt: A low-cost, low-energy alternative” took place at the Nile Hilton, March 13-15th, 2006 in Cairo Egypt. The workshop was primarily supported by financially by United States Agency for International Development's (USAID), Asian Near East Bureau (ANE), Jordan Mission, Amman, Jordan through an agreement with the International Arid Land Consortium (IALC). The workshop also received considerable support from the National Research Centre (NRC) in Cairo for the local organization. The workshop was attended by 85 participants. The attendees came from nine countries. The number of participants from each country was as follows: 55 from Egypt, 16 from Jordan, 5 from USA, 2 from Yemen, 2 from The Netherlands, 2 from Japan and one representative from Germany, Palestine and Tunisia.

The conference was opened by the vice president for research of the NRC (Prof.Dr. Osama El-Shabrawy), a representative of the Dutch Embassy (Frans van Rijn, Counsellor; Head Economic Affairs & Development Co-operation Department), Dr Saad AlAyyash from the Badia Research and Development Centre, Dr. Akrum Tamimi and Dr. Robert Frietas from the IALC, and finally Dr. Fatma El-Gohary, the Conference Chair, from the NRC together with Dr. Jules van Lier from Wageningen University and Dr. Jim A. Field from the University of Arizona. The conference was divided into eight separate sessions. These were made up of an implementation session, a round table on the application of anaerobic wastewater treatment and a final report of the Wasteval project (a Dutch-Middle East international project on anaerobic wastewater treatment and reuse in irrigation) as well as five scientific sessions. Additionally, on the second day of the workshop there was a technical tour of a full-scale newly constructed anaerobic wastewater treatment plant in Sanhour, Egypt.

The implementation session was conducted on Monday morning March 13th. Dr. Fatma El Gohary (NRC, Egypt) covered core principles of anaerobic treatment. Dr. Jim Field (University of Arizona, USA) summarized the state of the art of on anaerobic treatment with upward-flow anaerobic sludge bed (UASB) technology for municipal wastewater. Dr. Maha Halasheh (Water Environmental Research Center – University of Jordan) summarized pilot scale experiences in Jordan on anaerobic wastewater treatment. Dr. Jules van Lier (Wageningen University, The Netherlands) summarized the state of the art on the reuse of anaerobically treated effluents for irrigation. Based on the presentations it can be concluded that anaerobic treatment is a mature technology at full scale for the pretreatment of municipal wastewater in warm climates where the wastewater temperature is 20°C or higher. To treat wastewaters of colder temperatures some design modifications are required which increase the solids retention time (SRT) to enable good hydrolysis of wastewater suspended solids. Anaerobic treatment can provide savings in operation costs (no aeration) and a dramatically reduced production of biosolids.

The implementation session was followed by a scientific session on anaerobic treatment of municipal wastewater. In this session, Dr. Maha Halasheh described the role of anaerobic technology for decentralized treatment on the small scale. Dr. Hisham Halim (Cairo University) provided some results on the use of a fixed film reactor for anaerobic treatment. Finally, Dr. W. Suleimann (Royal Scientific Society, Jordan) discussed simple techniques employed at the household level to treat grey water for reuse in irrigation.

After breaking for lunch, the conference continued with a round table that was started out with two presentations on the design of the full-scale UASB of the technical visit (Herrie Heckman from Royal Haskoning, The Netherlands and Dr. Ahmad Moawad from the Engineering Consultant group, Egypt). Additional full scale experiences in Egypt with UASB plants was also discussed by Dr. Mahmoud Azeem from Ain Shams University, Egypt. His talk included both large scale projects as well as small scale community level projects. Finally the round table was finalized with a presentation by M. Mansour from the Ministry of Environment in Jordan describing full scale aerobic lagoons and aerobic activated sludge plants implemented in Jordan. After these talks a lively debate ensued on whether anaerobic treatment should be considered by the Ministry of Environment in Jordan.

On Monday evening, the NRC organized the Nile Cruise as the conference social event. The event included a dinner and local cultural entertainment. This enables attendees to become acquainted with one another.

The conference continued on Tuesday morning March 14th with an hour long session on the olive mill wastewater. Three papers were presented which were given by Dr. M Mosa (Royal Scientific Society, Jordan), Dr. Sami Sayadi (Sfax, Tunisia) and Dr. M. El Khateeb (NRC, Egypt). Judging from the large number of questions and lively discussions that accompanied each talk, it appears that olive mill effluents are a serious problem in the Middle East. These effluents are highly concentrated and need to be either diluted or detoxified for biological treatment.

After the morning session, the participants went on an excursion by bus to Fayoum, Sanhour (about 2 h drive from Cairo) to visit a recently completed constructed full-scale UASB plant (2304 m³). The plant has been constructed but has not yet been brought into operation. Thus a unique opportunity was created for a technical visit because it was possible to look inside the reactor and look at the technical details of the construction. These details included the influent distribution system, the three-phase separator (gas solid liquid separator) at the top of the reactor. The UASB treatment was to be followed by post-treatment with an existing biotrickle filter, which was also being revamped during the UASB construction.

The conference was continued on the third day, March 15th, with the first morning session dedicated to the final report of the WASTEVAL project. This included a talk by Dr. Jules van Lier (Wageningen University, The Netherlands) on the efforts in the Middle east to use treated water for irrigation; a talk by Dr. Nidal Mahmoud (Birzeit University, Palestine) on a UASB reactor combined with an anaerobic digester to improve the anaerobic treatment of municipal wastewater at colder temperatures (such as the winter in Palestine); a talk Dr. Maha Halalsheh (WERS-C-UJ, Jordan), who reviewed the process of developing a pilot scale installations at her

institute in Jordan and in the field next to existing wastewater treatment plants; and finally a talk by Dr. Saber A. El-Shafai (NRC, Egypt) who spoke of his research on the recovery of nutrients in wastewater in the form of duckweed for aquaculture.

The remainder of the day was dedicated to three scientific sessions. The first of these was a large scientific session on post treatment techniques to be used in conjunction with UASB technology. A UASB applied to the treatment of municipal wastewater is meant to remove a large fraction of the chemical oxygen demand (COD), biological oxygen demand (BOD) and total suspended solids (TSS) with the goal of lowering operation costs, reduce the biosolids production and the recovery of chemical energy in the wastewater as methane gas. However, in order to obtain high quality effluent with respect to low BOD, nutrient removal and pathogen removal, the UASB process needs an aerobic post treatment step. The talks in this session addressed alternatives technologies for post treatment. These include: constructed wetlands (Dr. Mohamed Ali El-Khateeb, NRC, Egypt); rotating biocontactors (Dr. Ahmed Tawfik, NRC, Egypt); downward hanging sponge known as the DHS system (Prof. Harada, Nagaoka University, Japan) and biological mats (Dr. Joel Cuello, University of Arizona, USA). The presentation on the DHS system was very impressive. The system is composed of a series of hanging foam sheets. UASB treated effluent is distributed at the top and the water flows down the sheets where it becomes aerated and residual BOD is removed. In addition there is partial nutrient removal and several logs of pathogen removal. The technique is very low cost as it involves no mechanical parts and no compressors for aeration. The DHS system was tested for 3 years at full-scale as a post treatment to a full-scale UASB plant in India with great success. In terms of pathogen removal the constructed wetland system presented by NRC provided the best results.

The next scientific session concerned the Reuse of Treated Effluents and Biosolids for Agricultural Production. Dr. Tamimi (University of Arizona, USA) discussed collaborative experiments between the University of Arizona and Royal Scientific Society (RSS) in Jordan on biosolids drying and pathogen die off. A model was developed that could predict pathogen die-off based on microclimatic inputs. Dr. W. Suleiman (RSS, Jordan) presented a paper on the use of biosolids for improving soil fertility and crop production in Jordan which demonstrated the fertilizer value of biosolids to selected crops based on field trials conducted in Jordan.

The last scientific session included one paper on low cost community level aerobic municipal wastewater treatment technology utilizing aerobic biofilters which was presented by Dr. El Nadi (Ain Shams University, Egypt).

The conferences ended with a general discussion in which M. Mansour from the Ministry of Environment in Jordan was asked a lot of questions about the acceptability of anaerobic pretreatment for the Jordanian situation. He said that his Ministry might consider the technology if presented with a good economic comparison between anaerobic pretreatment and aerobic post treatment on the one hand with aerobic activated sludge plant on the other hand.

Conclusions.

All in all the conference demonstrates that anaerobic technologies as a major treatment step are rapidly becoming implemented in Egypt both at the city-wide scale as well as small community scale for domestic wastewater treatment. Several full-scale UASB's have already been constructed and more are planned in Alexandria. The technology looks attractive for Jordan, however, some design modifications are required to make the technology fully functional during winters in Jordan when wastewater temperatures drop to 15°C. The conference also served to

make clear that there is a large number of viable options for post treatment to polish an aerobically treated effluents best exemplified by the DHS system. Most importantly the conference demonstrates that there is a lot of expertise in the Middle East on low cost biological wastewater treatment. The networking established at the conference will hopefully go a long way in implementing these treatment methods.