

# WATER AND LEACHATE MANAGEMENT AT A SANITARY LANDFILL IN EXTREME TROPICAL CONDITIONS, KUCHING, SARAWAK, MALAYSIA

R. DAMIECKI\*, M. SIPHON\*\* AND J. BILONG\*\*

\**Environmental Solutions, 41334 Nettetal, Germany*

\*\* *Trienekens Sarawak Sdn. Bhd., 93250 Kuching, Sarawak, Malaysia*

**SUMMARY:** In the extreme tropical area of Kuching with an annual rainfall between 6,500 and 7,200 mm a leachate treatment plant is operated which has to keep Standard B of the Malaysian Environmental Quality Act 1974. The plant consists of biological, chemical and physical treatment steps.

Since the plant's capacity is limited to 350 m<sup>3</sup>/d the landfill operation – especially surface covering – has to be done on a high level.

By using the statistical tool of the cumulated frequencies line it could be shown that the plant's performance with regard to the COD effluent concentration could be improved distinctly within the last two years.

## 1. INTRODUCTION

Kuching Integrated Waste Management Park (KIWMP) is located in the state of Sarawak, Malaysia. It has three main components; sanitary landfill, secure landfill and a hazardous waste incinerator. This site was identified after an intensive geographical and geological research was carried out. The total area covers 112 ha. Both sanitary and secure landfill were constructed section by section using TRISOPLAST as the base liner which is a highly impermeable and in many respects, a liner of superior to conventional liner systems. This seems fit to the requirement of this “fast track” project which was completed on 30<sup>th</sup> October 2004. In 2005 at the 19<sup>th</sup> Sardinia Symposium a presentation about the Park in general has already been given (Damiecki et al, 2005). This presentation will focus on the water and leachate management system.

Different from many examples of poor or even no leachate treatment which can be found in South East Asia and elsewhere the plant described below copes with all aspects of European and especially German Standards, see figure 1.

The park is operated by Trienekens Sarawak (TS).



Figure 1. Bird view of the KIWMP

## **2. RAINFALL**

In the area where the KIWMP is located the annual rainfall varies between 6,500 mm and 7,200 mm. This is one of the highest precipitation rates in the South East Asian area.

Figure 2 shows the results of the rainfall measurement of the year 2005 which has been done on site (KIWMP).

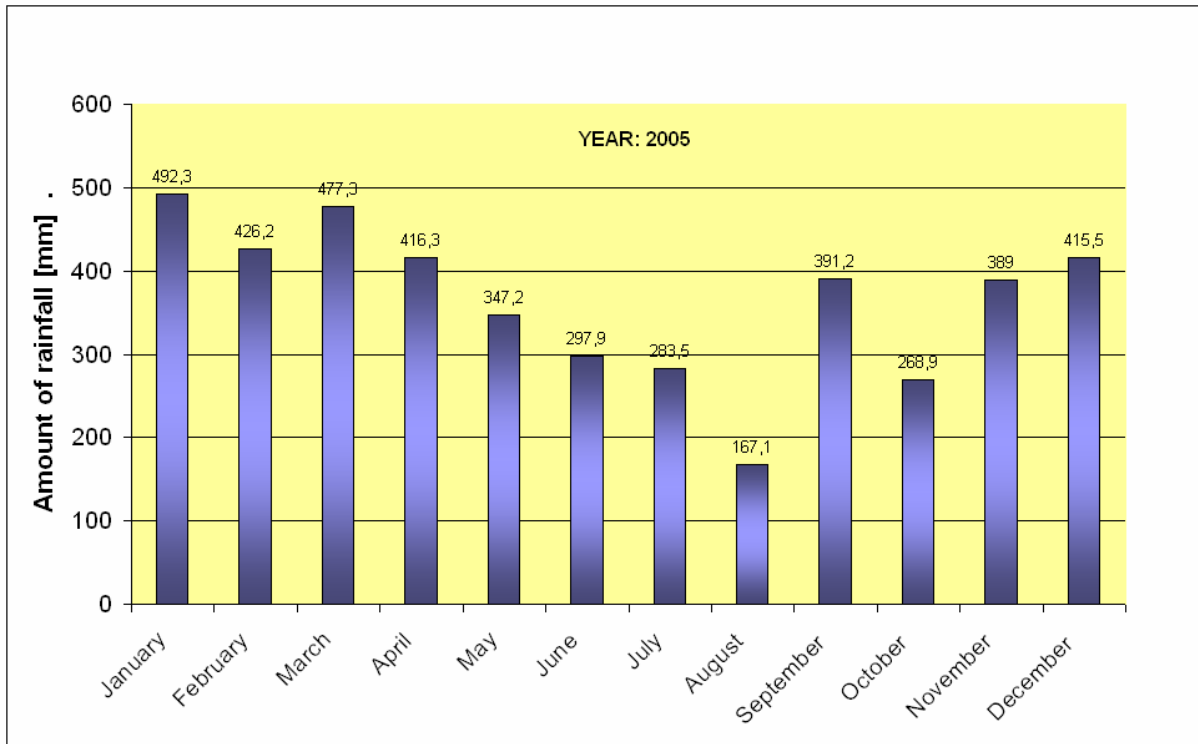


Figure 2. Amount of monthly rainfall at KIWMP for the year 2005

With a cumulated rainfall value of 4,370 mm the year 2006 can be deemed as a “dry year”. However, in comparison the precipitation in Germany on average is about 750 mm per year. In January 2005 at KIWMP e.g. we had already  $492/750 \cdot 100 = 66\%$  of the annual German rainfall.

### 3. LANDFILL MANAGEMENT

To cope with such an amount of water special landfill operation technologies have to be applied. At the KIWMP a special technique of covering the already waste filled cells of the landfill has been developed.

The first element of this technique is to divide the landfill area into different cells which are filled in sequencies which are calculated in advance. The filling sequencies have to be revised every three to six months according to the current filling progress. All cells which are not used for filling have to be covered.

The second element of the water management technique is the covering of the cells by using HDPE liners of 0.50 mm thickness, see figure 3.

Currently TS is doing field tests with HDPE liners of 0.35 mm thickness. The HDPE liners are fixed with earth nails.



Figure 3. Surface cover with HDPE liner

The rainwater which is collected by the HDPE liner can be channelled out by appropriate storm water drains. Thus leachate generation is extremely reduced.

Not necessary to say that the storage pond for the leachate should be roofed.

During one rainy day e.g. in January such a pond with a surface area of about 3000 m<sup>2</sup> could collect about  $0,050 \cdot 3000 = 150 \text{ m}^3$ .

Due to the existing leachate drainage and - collecting system which complies with German standards combined with the described landfill management at KIWMP all leachate can be collected and treated.

## **4. THE LEACHATE TREATMENT**

### **4.1 The Process Technology**

The leachate treatment plant which can be used for the joint treatment of the leachate of the Sanitary Landfill (SLF) and the Secure Landfill (SCL) consists of a four stage chemical, physical and biological process with a capacity of 350 m<sup>3</sup>/day. The technology has been supplied by a Singapore based company.

As for the flow scheme refer to figure 4.

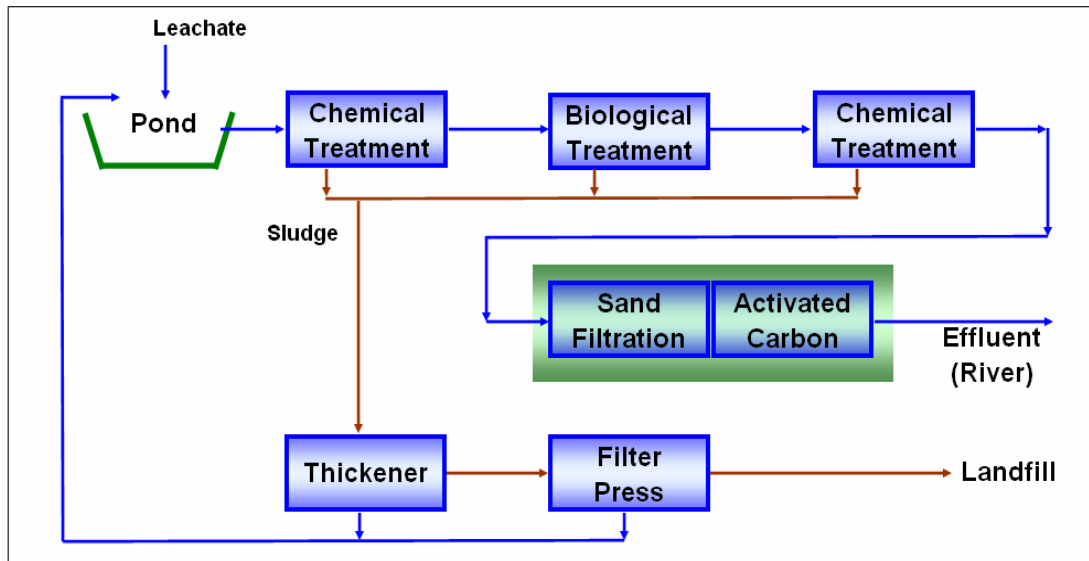


Figure 4. Flow scheme of the four stage leachate treatment plant

The process has been designed to keep Standard B of the Malaysian Environmental Quality Act 1974.

#### 4.2. Results

Since the beginning of operation in 2004 numerous samples have been taken and analysed by KIWMP's laboratory.

Here we focus just on the COD values.

After the landfill operation started in 2004, from May 2005 on a distinct change of the landfill characteristics from acetogenic to methanogenic could be realized by investigating the leachate of cell 1.

However because of the quick increase of the filling height of cell 1 and the start of filling in cell 2 due to the acetogenic conditions in these newly filled sections COD influent concentration increased again.

To show the whole variation of influent concentrations during the years 2006 and 2007 in figure 5 is shown the cumulated frequency line of the COD influent concentration measured in "pond3".

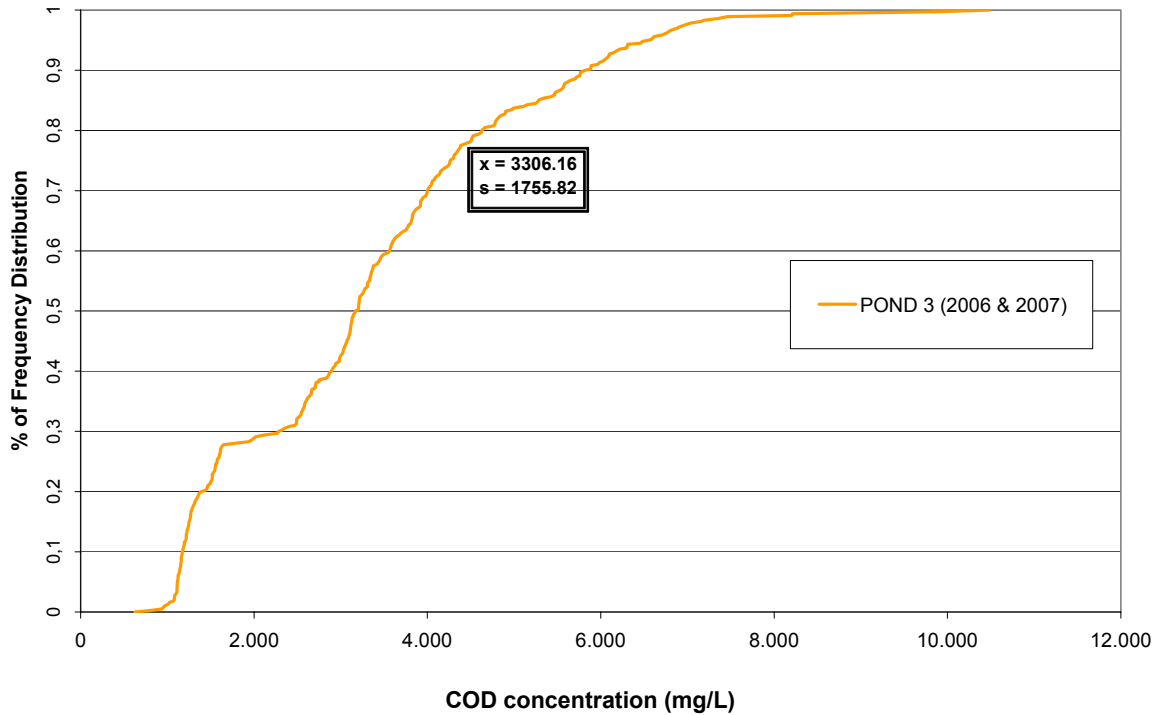


Figure 5. Cumulated frequency line of the COD influent concentration

The average influent concentration in 2006 and 2007 has been 3,306 mg/L. Ten percent of all values were less equal 1,000 mg/L, 90% less equal 5,800 mg/L. This frequency line is calculated based on about 600 grab samples. The efficiency of the LTP is ranging between 96% and 98%. The process stability has been improved continuously since 2005.

Especially flow variations caused by the landfill have a bad influence on efficiency and process stability of the LTP.

Therefore it is most important to do a sophisticated water management in the landfill.

During the oral presentation the most recent results of the plant's performance in 2006 and 2007 will be discussed. This will be done by using the cumulated frequency lines of the COD effluent concentrations.

## 5. CONCLUSION

The numerous samples taken since mid of 2004 until today show the LTP at KIWMP usually complies with Standard B of the Malaysian Environmental Quality Act 1974.

However, flow variations sometimes occurring due to the extreme tropical conditions may influence the plant's performance.

Therefore all measures to keep the rainwater out of the landfill-body have to be taken in the landfill's water management.

## **ACKNOWLEDGEMENTS**

The authors wish to thank Ms Dayang Sherrynazara for her valuable, comprehensive analytical work at KIWMP's laboratory.

## **REFERENCES**

Damiecki R., Domroes J., Siphon M. & Bilong J. (2005) Kuching Integrated Waste Management Park.

Proceedings Sardinia 2005, 10<sup>th</sup> International Waste Management and Landfill Symposium, 583.