Test Report

Water Treatment in a selected part of a Sewage Water Canal in Shanghai

Duration of treatment: 2008.6.24 -2008.10.6.

Version 6

2008.11.6

Content

Participating Institutions

Meridian Technologies, Dubai
BioAktiv GmbH, Germany
Rusky Holdings, Shanghai
Technical University Shanghai

1. Preface

A series of various tests has been carried out in order to adapt the proposed materials and the corresponding technologies for the treatment of polluted waters to the precise conditions in Shanghai. The goal was to determine the optimal mode of application.

A Biocatalytic Technology **(BCT**) in combination with Photo Catalytic Effecting Materials has been proposed by Meridian Technologies for the scheduled test.
This Technology has been used very successfully in many countries to treat eutrophied water bodies like lakes, ponds and canals. It can be used in all climatic zones for standing or weakly flowing water bodies with fresh or salty water.

The water bodies to be treated in Shanghai are eutrophic, due to the discharge of untreated sewage. These eutrophied water bodies have lost their ability of self-purification, which is a characteristic of healthy water bodies. The BCT enables the water bodies own complex natural processes to regenerate and maintain a sound equilibrium. The technology effects through the interaction of a complex of biochemical measures. The main approach involves the use of Biocatalytic and Photo Catalyst Materials and Bioreactors.

Biocatalytic products prevent putrefaction of biological materials like animal and human excrements. Instead they initiate the process of rotting. Thus putrefaction does not take place. In result of that, the generation of harmful gases like ammonia, methane and laughing gases is reduced and environmental burdens strongly decrease. The subjective well being is improved as well, due to the reduction of unpleasant odours of these gases.

The detailed description of the technology and the used materials can be found in Appendix 1.

2. Initial Situation

The chosen part of a waste water canal has been proposed by the Governmental Environmental Agency of Shanghai. It is representative for thousands of kilometres of similar canals in Shanghai and other Chinese cities.

Location:	Liuzaogan, Xinchang town, Nanhui district, Shanghai
Length:	480 m
Wide:	14 m in average
Depth:	1,5 m in average, varies between 0,5 m and 2 m. The bottom is at all parts covered with a 0,3 m – 1,0m thick layer of sludge
Water Quality:	4-5

Initial situation at Location E

The water is flowing at a speed of about 1,2km/h. The direction of flow is switching two times daily, so untreated water is permanently flowing in the testing sector. In one direction the canal flows into the open sea after 20 km, in the other direction it flows out into another canal / river after approximately 5 km.

The waste water in the treated canal consists mostly of domestic waste water including excrements. The permanently noticeable smell nuisance was extraordinary strong at certain locations. Untreated industrial waste water has been temporarily discharged at some neighbouring canal-districts.

3. Test Procedure

Water samples have been taken at the above marked locations at the same daytime, in a depth of ca. 30 cm. The analysis has been carried out in the laboratory of the Governmental Environmental Agency and independently of that also in the Technical University. Both

results are basically matching. To prevent confusion of both matrixes the following analysis uses only the data of the Governmental Environmental Agency.

The measurement data of both sources may be found in Appendix 3.

The tests were carried out in three phases. All samples in Phase I and II were taken in 7 day intervals. Each taking of samples was made at the same time for all Locations. These "Points" refer here to a point in time (see Diagram I).
The second water analysis of Phase III has been carried out only two days after the treatment (at 2008.09.19 at Point 14). Point 15 was analysed six days after the treatment at 2008.09.23 Point 18 was analysed three weeks after the treatment. The Points have been chosen with some variations to demonstrate the quick (Point 14) as well as long lasting effects (Point 18) of the treatment.

Phase I: 2008.06.24 – 07.22

Phase II: 2008.07.23. – 09.16

Phase III 2008.09.17 – 10.06

In Phases I and II the complete test-range was treated, from Location A to B and E to D. In **Phase III** only the canal part in **Location E** has been treated. All data indicate that the improvements of pollution data in Phase III especially take place in Location E. Other Locations have been slightly influenced, due to the current that carried treated water away from Location E.

Different types of Bioaktiv materials have been used: BA – Water (BA-W) and BA – Sewage (BA-S). Additionally Akeron was used.
Akeron was used only in Phase III (in combination with BA – W and BA – S).
The products used for bio catalytic technology are all made out of natural raw materials, are non-toxic, and have no side-effects. Bioaktiv is not harmful to people, animals, marine life or the environment.

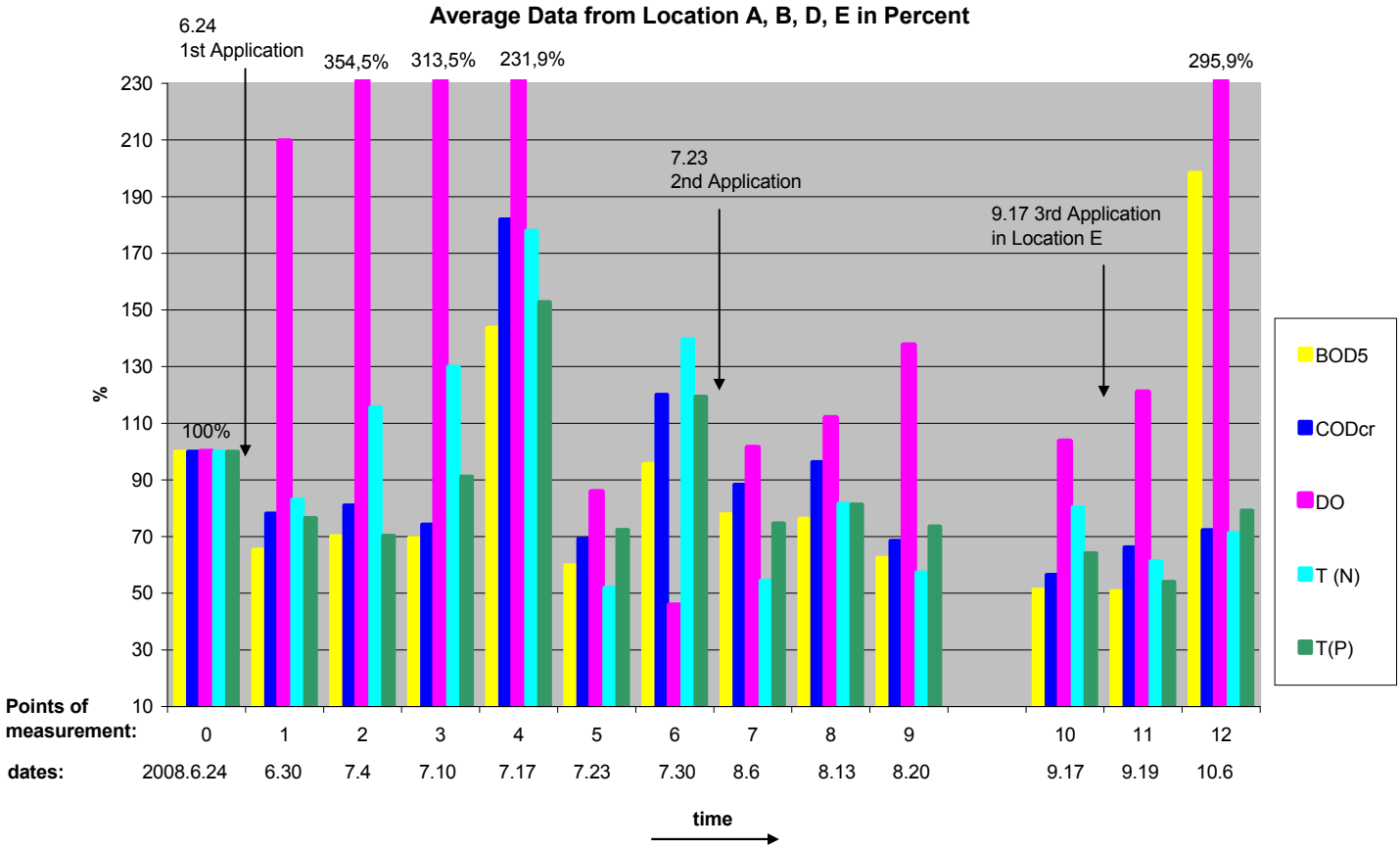

Diagram I: Average Data of the main Locations for Biological Oxygen Demand (BOD5), Chemical Oxygen Demand (CODcr), Dissolved Oxygen (DO), Nitrogen (T N)), Phosphor (T(P))

4. Test Results

All test results can be found in the 23 attached Diagrams in Appendix 5.

4.1 Description of Results

The diagrams show the change in percent of each point of measurement in comparison to the first Point, which is always 100%. All variables can thus be easily compared for their timely development. X axis have the same scales for all variables. Y Axis are in most cases ranging form 10% to 230%, in some diagrams from 0% to 800%.

The data won from Location E has the highest authority to assess the effects of the used technologies because Location E is, in contrary to the other Locations, not biased by permanent inflow of water from the main canal, although there is a permanent influx of waste

water, especially excrements from the near by neighbourhood (see Aerial Map at the front page).

Already at Location D a mingling with the water from the main canal is taking place. This has been clearly observed by eye sight at 2008.09.19 At this Point of time the water in Location E was clear and greenish, in the main canal yellow and muddy. The mixing of the water of both colours could thus be seen at Location D.

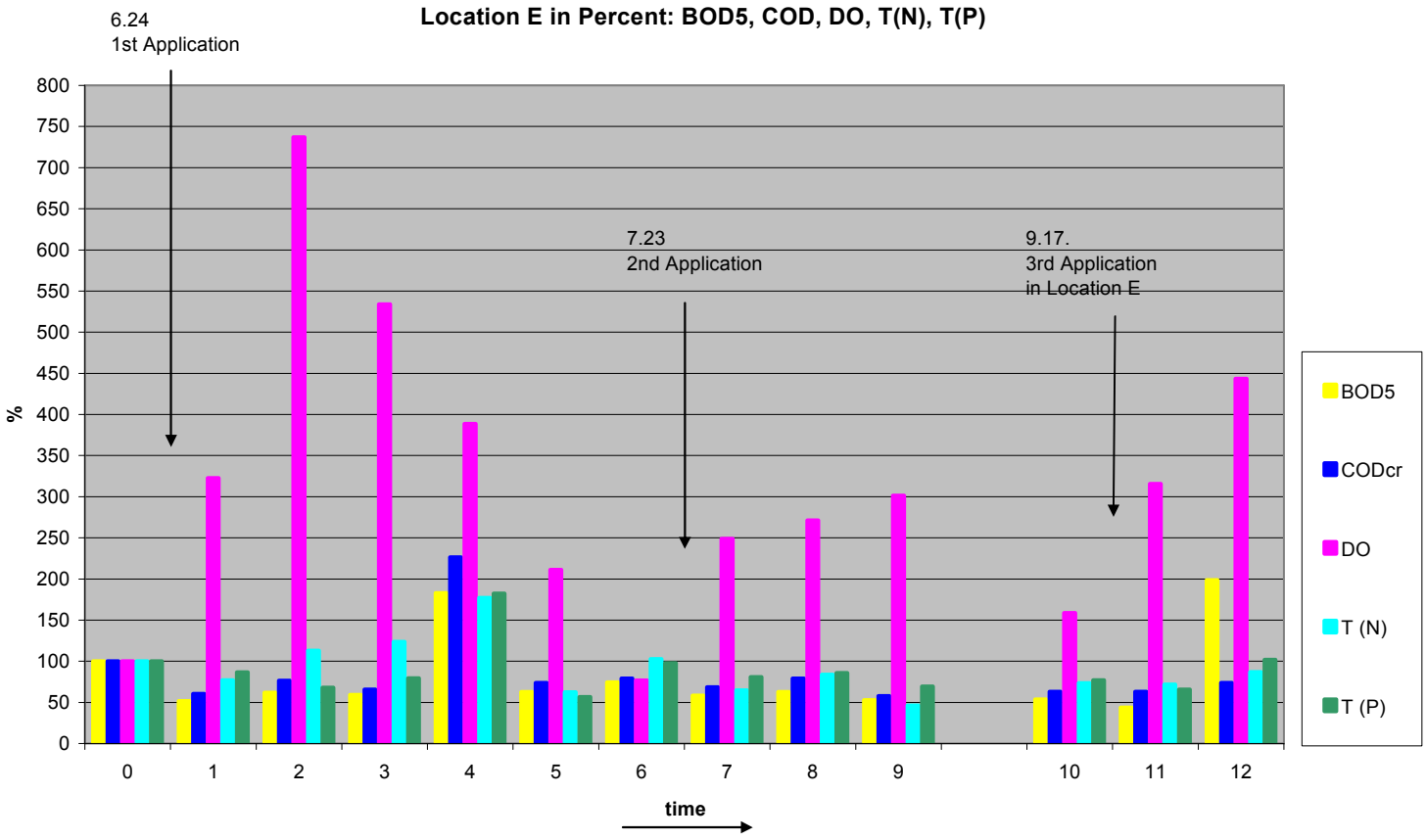

Diagram II: development of Location E in percent; first measurement (0) = 100%

The treated part of the main canal is located between the Locations A and B. Although polluted water from the untreated stretch of the canal was permanently flowing in the test-range, the effects of the treatment - of course weaker than in Location E and D - were still clearly visible.

A comparison of the Locations shows an extraordinary increase of COD and BOD5 at Point 4 (2008.07.17) for Location E, D and A (Diagram I). The direction of the current at this period was probably from B to A. There must have been in preface to the measurement an

extraordinary strong polluted inflow at Location A or E, or both. This has probably been untreated industry waste water from one of the factories next to Location G.
A second extraordinary increase in pollution indicators took place at Point 6 at Location A and to a lesser degree at Location D. An influx of untreated industrial waste water at Location A must have taken place with a current from A to C.
The increase of the COD at Point 6 and 8 at the Locations B and C is probably also caused by industrial waste water in these Locations or outside of them at Location C.
The influx seems to have been of limited time, since the COD and BOD5 decreased from very high peaks, after a short time to a level below Point 5 and 1. Thus it can be proven that the effect of the treatment caries on even when a short term influx of pollution takes place.

4.2 Interpretation of Results

In order to ensure a good comparability all Diagrams are showing the variation in percent compared to Point 0 (100%) during the time of the research.

Dissolved Oxygen (DO)

To assess the enduring long term effect of the Bio Catalytic Technology the ratio of dissolved oxygen in the water is especially important. As explained earlier the goal of the whole treatment is to influence the condition of the water in the canal in such a way that its self-cleaning mechanisms are enforced, so that the water is entering in an aerobic state. This achievement is very much depending on the DO ratio. The DO ratio has to increase.

In Diagram II it may be seen that the data for DO improved at all Locations after the first treatment. The best effect takes place at Location E, especially in Phase III. In that Phase exclusively Location E was treated and therefore shows the only and very sharp increase in DO. The other Locations, that where untreated in Phase III, show a worsening of DO in the beginning and increase only later and less steeply.

It must be emphasized, that the increase in the ratio of DO at Location E was **100% in two days and 180% in 19 days**! The consequences of the high oxygen rate where clearly visible:

- depth of visibility was thoroughly better, water was much clearer

- plenty of fish could be seen at Location E (only there). At 2008.09.19 there were much more fish than at the 2008.09.17
- The smell nuisance at some spots of Location E at the 2008.09.17 had completely vanished after six days. In contrast to that there was no improvement in the main canal.

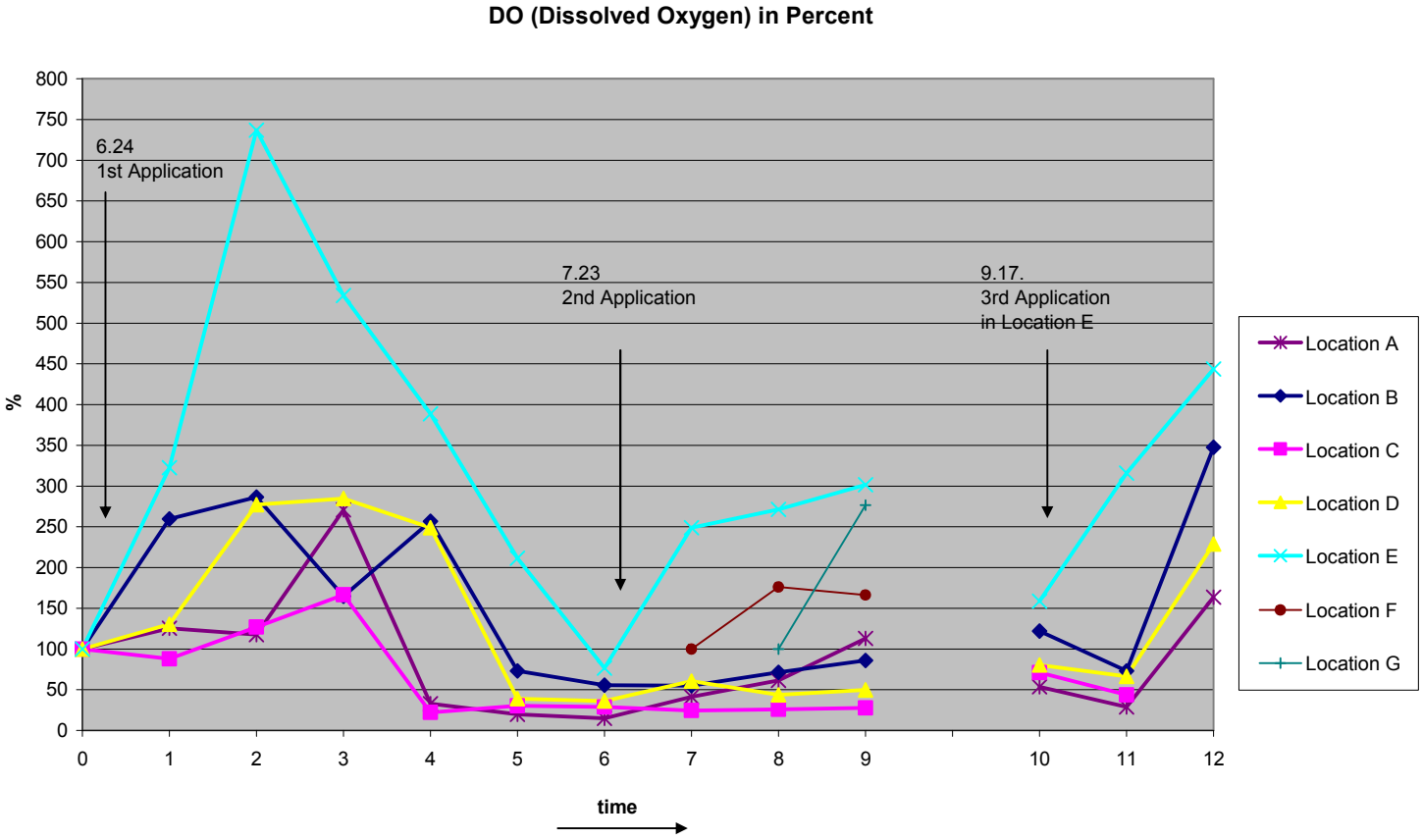

Diagram III: content of Dissolved Oxygen, first measurement (0) = 100%

BOD5 – COD

Both variables decrease as a consequence of the treatment at all Locations. At the end of the treatment they were at all Locations at a significant lower level than before the beginning of the treatment. Only in the Last Point BOD increased, probably due to pollution influx. This is shown by Diagram XV, XVI and XVII in the Appendix.

At the end of Phase III in Location E, there is a stagnation of COD. This will improve on the long term. On the other hand the BOD decreased at this Location and point of time in two days by 56,2 %.

Nitrogen (TN, NH4+)

As explained earlier, the growth of aerobic bacteria and certain green algae is stimulated by the BCT. Green algae consume oxygen and decompose nitrogen-compounds (NH4+, NO3), a denitrification takes place. Parallel to the rising quantity of dissolved oxygen in the water, the content of T (N) was reduced in the test after each application. NH4+ was even reduced to up to 70%, especially after the 3rd application.

Phosphor T (P), PO4)

After each application an obvious decrease in phosphor took place. That is probably the case because bacteria use phosphor. After the 3rd application the phosphor rate decreased by 30% after only 2 days.

Transparency, Suspended Solids (SS)

A clear decrease in suspended solids and parallel to that an increase in transparency took place after the 2nd and 3rd application, especially at the Locations E and D. In this case too, it is to be assumed that bacteria use and thus decompose particulate material (suspended particles).

4.3 Concluding Interpretation

At 2008.9.17 (Point 14), after the 3 month of testing, all variables have improved at each single Location and also in average, in comparison to their initial situation.

The analysis of the collected data shows at the involved Locations A, B, D, E for **all variables** a distinct improvement after 1 – 2 weeks following applications 1 and 2, and after 2 days, following the 3rd application. After that the water data worsens because the treated water is permanently mixing with water from untreated parts of the canal. The mixing of treated and untreated water has consequently a positive effect also on the untreated canal parts, that was observed at Location C and G (both untreated).

The best proof for the positive effect of BCT is the 3rd application in Location E. While DO is worsening in the untreated Locations it strongly improved at Location E.

At 2008.10.6, three weeks after the 3rd application, the main characteristics of Location E had increased, better than at 2008.9.19. Also two weeks later at 2008.10.21 the water quality of location E was much better than in all the other parts of the test area. The water was clear and without bad odour.
That means the natural processes of self-purification started and will clear the water continuously for a long time.

Samples of Locations A, E, D at 2008.10.21

Contact Point of the water bodies of two canals

5. Proposed Procedure

The applied Bio Catalytic Technology is suitable to improve the water quality of sewage water canals like in the test area permanent and significant, if the following measures are realised:

- Treatment of the whole canal or at least larger, connected parts
- Application of BA-W, BA-S and Akeron. The application should take place two times in the first year, from the beginning of the second year once a year.
- Additional application of Bio Reactors (appendix 6) in a distance of 500m each

6. Possible Effects and Goals

Improvement of the indicators of pollution: DO, COD, BOD5, T(N), T(P) according water class 2.

- Significant improvement of the depth of visibility to at least 50 cm
- Reduction of the germ number (bacterial count)
- Reduction of the mud layer after three years for at least 80% - 100%
- Widely reduction of the smell nuisance.

The currently existing threat to the health of the population by the high quantity of dangerous pathologic germs is significantly reduced or dispelled. Due to the reduction of bad odour the living quality of the population will increase with the environmental quality.

Two parts of the Canal at Location E after the Treatment