Date: 17.05.2010

Report on recent trial in an industrial cooling tower sump

To whom so ever it may concern

Sub: Trial study on Control of Organic Matter in the industrial cooling water sump of Panipat Refinery, India.

Cooling tower is one of the most important infrastructures in any industrial establishment as well as domestic air conditioning. The purpose of these cooling towers is to cool the circulating water through evaporation. The water is sprinkled from the top of the tower and allowed to come in contact with draft of ambient air. Part of the water is evaporated with the air and the remaining water attains a lower temperature. This water is again circulated in the heat exchangers, air conditioners and also used in the process in a chemical industry. Although the principle of the functioning of the cooling towers is very simple, the maintenance of the quality of the circulating water is not that easy. Algae and biofilms are the major enemies of the cooling tower water and one has to spend a fortune to keep the build up of the algae and deposit of bio films on the surface of the tower, under control.

In this particular location, a huge cooling tower is operating to provide cold water for different sections in the process as well as in the heat exchangers. There are three towers which are continuously operating and the water from the bottom of the tower is pumped to a common sump, from which the water is supplied to different sections of the plant.
The usual practice is to add chlorine and sometimes chlorine dioxide to ensure a certain level of residual chlorine in the circulating water. In addition, several other chemicals for corrosion, pH, algae control etc. As a general practice fixed quantities of these chemicals are added at certain intervals but the chlorine addition is dependent on the concentration of organic matters in the circulating water. When the organic matter concentration is high, it is difficult to maintain the residual chlorine level with lower dose and accordingly the dosing level is required to be increased.

The problem was to maintain the residual chlorine level even if chlorine dosing at this level. Also there were heavy deposits on the surface of the different sections of the tower and the surface of the water in the sump was always covered with floating oily sludge.

With the objective to reduce the growth of algae and to reduce the chemical consumption a joint trial was undertaken with M/s Managing Innovation to establish the performance of ultrasonic systems. The dimensions of the cooling tower sump and its operating parameters are given in T**able 1.**

Table 1 : Operating parameters of Industrial cooling tower in question

Sump Capacity	2200 m3, aprox.
Sump Dimension	lenth 30 Mtr, * Hight 15 Mtr, * Width 7 Mtr
Flow Circulation	15000 m3 to 20000 m3 /hr.
Clorine Dosing	15 kg/hr. to maintain residual chlorine level.*

- *The chemical consumption data is available on monthly basis.*

Considering the low residence time of water and very high turbulence in the sump, it was decided to install two units of ultrasound transducers at two different corners as shown in fig. 1, to avoid chance of interference between the units as far as possible. Accordingly, two units of Ultrasonic NT 4.1 from M/S Thomas Electronics was installed and the chlorine and chlorine dioxide consumption was monitored on monthly basis since the chemical and chlorine (and chlorine dioxide) consumption data is available only on monthly basis at this location. The cooling tower was cleaned and the entire water was replaced after shutdown. The ultrasonic devices were installed during the middle of November, 2009 and were withdrawn on 17th.February, 2010.

Since the entire cooling tower was on shut down and restarted during early November, 2009, no sustained basic consumption data was available. Also after the shutdown, the entire inventory of circulating water was replaced with fresh water.
Before shutdown the average monthly consumption was about 15 KG. per hour (10800 Kg. per month). The consumption of chlorine and chlorine dioxide was very high just before the shutdown in Sepetmber, 2009 even with this level of chlorine dosing; it was difficult to maintain the residual chlorine level in the circulating water. However, such high level of chlorine consumption could not be considered as a sound basis, since there were several leakages of heat exchangers, which was responsible of oil ingress in the cooling water circuit, which in turn, could be responsible for high consumption of oxidizing agent, namely, chlorine.

The units were supplied only with continuous power of 40 W. The units worked quietly, without requiring any other attention. The trial was continued for 3 months and our observations are as below:

1. The surface of the sump was found clean. It was decided to observe the chemical consumption for several months after the units are removed. (observation made on 23.02.2010).

2. The chlorine consumption data during Nov. 2009 to February, 2010 is shown in table : 1. It could be seen that for the first two months the chlorine consumption was quite low and there was no difficulty in maintaining the residual chlorine. Although the consumption of chlorine and chlorine dioxide was unusually high during January to February, 2010, it was again at lower level during February to March, 2010.

3. Subsequently, we compiled the data for 17th. February to 16th. March and 17th. March to 16th. April, 2010. The chlorine and chlorine dioxide consumptions were as below:

	17th. February to 16th. March	***17th. March to 16th. April***
Chlorine	5433 Kgs.	8900 kgs.
Chlorine Di oxide	200 Kgs.	2250 Kgs.

The consumption during March to April, 2010 was almost at the level prevailing before the shutdown.

It could be appreciated that there are several factors other than algae and bacteria formation, which could influence the chlorine consumption. The leakage in exchanger leads to oil ingress in the cooling tower circulating water, which significantly influence the chlorine consumption as well as the makeup water quality. Therefore, it is very difficult to draw any accurate quantitative conclusion on the reduction of chlorine consumption, based on a trial for such a short period.

Given below is the actual data based on which the report above was prepared:

Date	**Chlorine (Kgs.)**	**Chlorine Di oxide (Kgs.)**	**Total Chlorine + Chlorine di oxide (Kgs.)**
17th. Nov. to 16th. Dec. 2009	5643	0	5643
17th. Dec. 2009 to 16th. Jan. 2010	4883	300	5183
17th. Jan. 2010 to 16th. Feb. 2010	4651	1800	6451
17th. Feb. 2010 to 16th. March. 2010	5433	200	5633
17th. March, 2010 to 16th. April 2010	8900	2250	11150

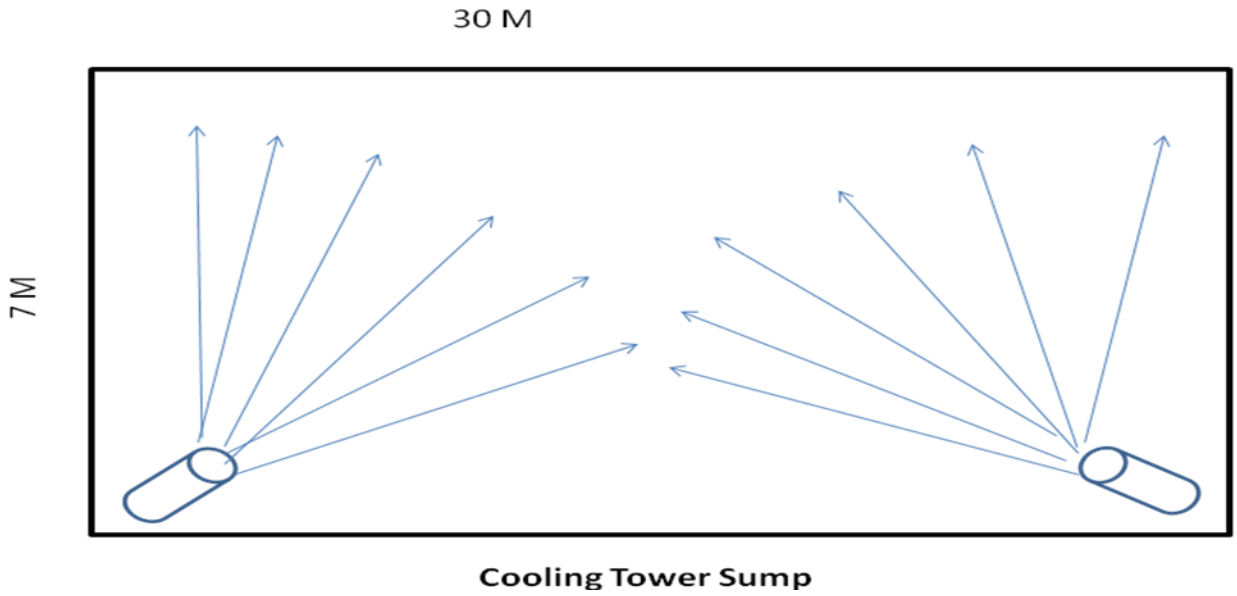
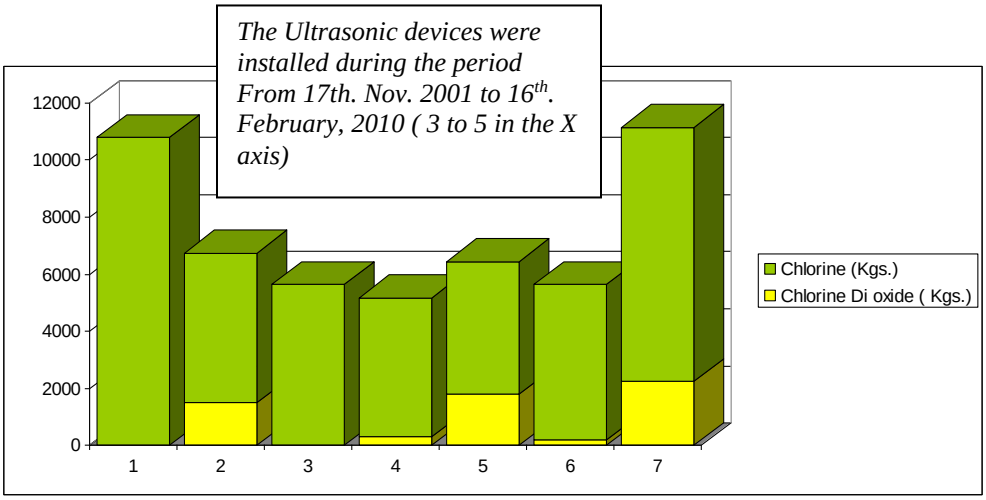


Fig: 1 Positioning of Ultrasound Transducers.

Consumption of Chlorine and Chlorine Dioxide in cooling Tower sump, during the trial period



Monthly Consumptions in KGs. *:*

1. *Before Sept. 2009 ,* **2**. *During September 2009* **3**. *During 17th. Nov. to 16th. Dec. 2009,*
4. *During 17th. Dec. 2009 to 16th. Jan. 2010,* **5**. *During 17th. Jan. 2010 to 16th. Feb. 2010 ,*
6. *During 17th. Feb. 2010 to 16th. March. 2010,* **7**. *During 17th. March, 2010 to 16th. April 2010.*

Fig.:2: Chlorine and Chlorine dioxide consumption in Cooling Tower Sump.

The performance conclusively proves the ability of the ultrasonic wave to control growth of algae in cooling tower sump, in-spite of high level of turbulence and very low residence time of water, in the sump. Most of the intangible benefits could only be realized once the systems are in constant use for longer period. Such benefits include clarity of the water, reduction of unwanted smell, low bacteria level in the water and absence of bio film formation, etc.

**** As approved by the concerned refinery.***