



P. T. INDOCEMENT TUNGGAL PRAKASRA, TBK

Cooling Tower Improvement: Revised Fan Procedure, Regular Cleaning, Float Valve Repair

SUMMARY OF THE OPTION

Indocement is one of the largest cement producers in Indonesia, established in 1985 and currently operating 12 plants located in different areas. The existing cooling water tower of powerhouse at indocement plant is a Marley, Sigma 1244, and vintage 1992. It is a wooden tower with four cells. It was observed that two of its cells, are idle, i.e. with no water flowing through them at all, yet the fan of each cell is running continuously. It is also suspected that the excessive algae growth throughout the tower may be due to the wastage of a large proportion of biocides in the overflowing water. The PVC fills and side louvers are coated with a thick layer of cement dust.

The necessary action plan for the implementation of this option is by revising the standard operating procedure for tower cells and regular cleaning of the tower (once in three months) using hypochlorite to remove algae and cement dust. This will eliminate any microbial hazard to all personnel at the plant and will improve the cooling efficiency at the tower, as well as to safeguard plant equipment that requires cooling water from excessive fouling on heat transfer. Repairs to the fill float valve will be required to minimize water losses due to basin overflowing. An investigative study of using in-ground-source heat pumps (IGSHP) in-lieu of cooling towers may be an option in the future (when the cooling tower is worn out and due for replacement or extensive refurbishment).

The result of implementing the option will give an energy saving of 250 MWh per year that will reduce the greenhouse gas emission up to 181 tCO₂ per year. The energy saving is estimated equal to annual cash inflow of Rp 133,297,920 or US\$ 14489 and this will return the initial investment cost (Rp 250,000,000 or US\$ 27174) in period of 1.8 years.

KEY WORDS

Indonesia, Cement, Power House, Cooling Tower, Fans & Blowers

OBSERVATIONS

During the in plant assessment, the cooling tower was inspected and it was observed that two out of four cells are idle, i.e. with no water flowing through them at all, with the fan of each cell running continuously. The flow control valves to all four cells were opened. Yet the two cells on either side of the tower were running dry. The Team was informed that this is a normal operating procedure regardless of how many boilers or turbines are online. At the time, both the turbines and five out of nine boilers were online.

The cold-water basin was overflowing continuously, indicating a failed fill valve. Chemical (Biocides and corrosion inhibitors) are continuously injected at the preset rate with no feed back control regulating their flow. The point where the chemicals are injected into the cold-water basin is adjacent to an overflow point of the basin's water into drain. It is suspected that the excessive algae growth throughout the tower may be due to wasting of a large proportion of biocides in the overflowing water. The PVC fill and side louvers are coated with a thick layer of cement dust.



The fan motors are 50HP, 400V, 60 A, $\text{Cos } \phi = 0.54$ (average of the four fans). A non-intrusive transit-time flow meter was used and the water circulation was measured at 2400 m³/hr. Temperature in and out of the tower were 38°C and 32°C, respectively.

OPTIONS

The standard operating procedure was revised for the tower cells resulting in the following options:

- A detailed review of the required number of tower cells to be maintained on line under different operating conditions needs to be addressed. Under the above conditions, it was obvious that two cell fans of the idle cells could be switched off to save electric power (a simple no cost solution).
- Regular cleaning of the tower (once per three months) using hypochlorite to remove algae and cement dust will be necessary. This will eliminate any microbial hazard to all personnel at the plant and will improve the cooling efficiency at the tower, as well as to safeguard plant equipment that requires cooling water from excessive fouling on heat transfer surfaces.
- Repairs of the fill float valve will be required to minimize water loss due to basin overflowing.
- An investigative study of using in-ground-source heat pumps (IGSHP) in-lieu of cooling towers may be an option in the future (when the cooling tower is worn out and due for replacement or extensive refurbishment).

RESULTS

The Cooling Tower program maintenance and boiler testing is shown below:

NO	SCOPE OF WORK	DAYS									
		1	2	3	4	5	6	7	8	9	10
1	Cooling Tower service										
2	Retubing Condensor										
3	Welding deaerator										
4	Cleaning oil cooling steam turbin										
5	Repair and painting cooling pipe steam turbine										
6	Repair leak of valve steam - valve to system superheater if not the steam turbine is stop - valve in the deaerator - main valve superheater and flange steam boiler 3, 6,7,9										
7	Repairing and replace the pipe in the pipa cooling tower										
8	Service the water flow valve in cooling tower										
9	Blowdown steam modification in cooling tower										
10	blowdown system modification in flash tank										
11	Condensate modification pipe in engine 9										

- During the reparation, the Cooling Tower was not yet completed, therefore the regular cleaning of the tower using hypochlorite and repairing or replacing fill float valve to minimize water loss was not implemented.
- Presently, the Cooling Tower is not in good condition, where two out of four cells in the Cooling Tower is exhausted / damaged. Moreover, one of the material cells inside the bars is missing. Therefore the procedure for Cooling Tower operation efficiency needs to be revised, even though the efficiency can still be monitored by switching off one of the fans, when only



three to four boilers are operating. Cooling Tower repair can only be done when the plant is shut down, which will need 10 days. The reparation costs were being calculated at time of writing of this case study.



Figure 1. Cooling towers

- The standard operating procedure (SOP) for recent condition is only if three to four boilers (of eight boilers) are running, the Power Efficiency can be improved by turning off one fan from Cooling Tower Fan Power, per cell 46.4 Hp (34.8 kW).
 - Revisions to the SOP are to be made after the cooling tower is repaired. The cooling tower must be repaired, but at time of writing of this case study the repairs are halted as plant shutdown is needed because they need ten days to repair.
 - Based on boiler tests on December 8, 14 and 15 2005, it is known that one of the fans of the cooling towers can be turned off, if the boiler runs less than five units. If the boiler runs five units or more, there is an increase of hot air in the generator, of more than 65 °C and hot water of more than 55 °C, which is the limit for boiler performance to avoid damage, therefore a risk to continue. After repairing the cooling tower, the performance will be better, where it is hoped that one of the fans of the cooling tower can be turned off even if all the boilers are running.

Expected savings from improved Cooling Tower performance are as follows.

Financial benefits

- Investment: Rp 250,000,000 or US \$ 27,174
- Annual cost savings: US\$ 14,489 (34.8 kW X Rp 532/kWh X 24 h X 300 days = Rp 133,297,920), based on the following figures:
 - Energy costs: Rp 532 per kWh
 - Plant Operation: 300 days
 - Energy savings per day based on one fan turned off: 34.8 kW
 - 1 US\$ = 9000 Rp
- Payback Period: 1.8 yr (250,000,000/ 133,297,920)

Environmental benefits

- Annual electricity savings: 250.56 MWh (34.8 kW per day X 24 hours X 300 days)
- Annual GHG emission reduction: 181.41 ton CO₂ (emission factor sourced from UNEP GHG Indicator: www.unep.org/energy/tools/ghgin/)



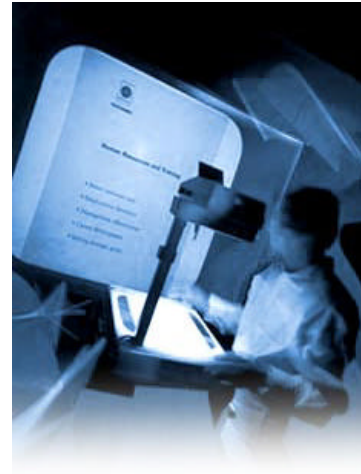
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