IMPROVING CHILLER EFFICIENCY IN A COMMERCIAL BUILDING

By Deepak Uppal

The increase in energy consumption treatment has significantly reduced de-scaling to only one time in a year.

The Client

Spread in simplicity and elegance client is a commercial building consisting of over 8,70,000 sq. ft. of office space with perfect synthesis of design, style, and efficiently planned office space. The complex boasts of a one-acre central landscaped courtyard/piazza and a specially designed "Bean Garden" provides welcome aesthetic relief. The ideal hangout retail space and some of the top brands are Starbucks, HDFC, McKinsey & Co., TCS, Lenevo, Nukkadwala etc.

Problem Areas

Chillers represent a substantial capital investment and are a major contributor to operating costs in commercial facilities. For many organizations, chillers are the largest single energy users, and comprehensive maintenance is critical to ensure their reliability and efficient operation. HVAC System in buildings is operated continuously round the clock and is subjected to variable heat load.

Following client issues were identified:

- Increases in frequency of condenser descaling (increase in approach temperature).
- High energy consumption due to improper heat rejection by the system.
- High scale on cooling towers fills resulting in low efficiency of cooling tower.
- Restricted water flow due to scale in pipelines resulting in low efficiency (water consumption/ heat transfer).
- Increase in chillers operational cost.

The presence of scale in the condenser or evaporator tubes indicates improperly treated water.

Analysis

Based on the client issues, a survey of the system was conducted and various parameters were recorded and complete analysis reports were prepared and discussed with the client and improvement were suggested and mutually applied to achieve desired results.

Heat transfer has the single biggest impact on chiller efficiency. Clean condenser tube surfaces result in the most efficient and most economical operation of the chiller. Keeping the heat transfer

Before Treatment **Through Regular Treatment**

surfaces clean is essential to operating at peak performance and reducing maintenance costs. Effective water treatment can eliminate fouling and deposition, which will result in lower energy costs.

Basis cause of the issues as identified was improper cooling water management and chemical treatment programme as water is used as a media for heat transfer in client chillers. Anything that interferes with heat transfer or that impacts the integrity of heat transfer makes the system less efficient and increases costs. Problems that are directly related to ineffective water treatment programs are corrosion, deposition (scale) and microbiological fouling. Existing formulation of chemicals were analyzed and requirement were studied and suitable compositions were suggested.

Following formulation was devised irrespective of chemicals suppliers:

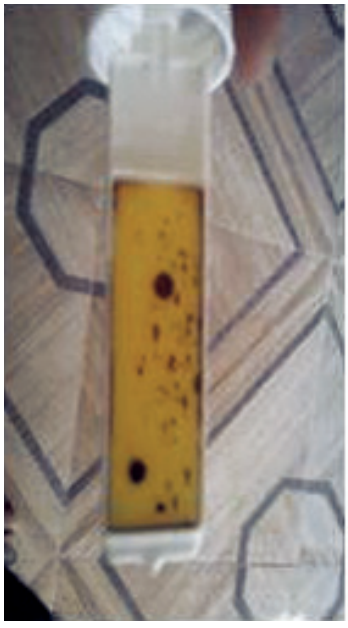
Chemicals for Cooling Tower	Formulation
Scale Inhibitor	2-Phosphono Butane-1,2,4-Tricarboxylic acid (PBTC)
	a) Zinc: Cathodic Corrosion Inhibitor
Corrosion Inhibitor	b) Ortho Phosphate: Anodic Corrosion Inhibitor
	c) Phosphonate: Cathodic Corrosion Inhibitor
Oxidizing Biocide	a) NaBr/Benzalkonium Chloride
	b) Surfactants
Non Oxidizing Biocide	5-Chloro-2-Methyl-4-Isothiazolin-3-one

Monitoring

- Few points were suggested to monitor for desired result and further analysis of improvement in the system.
- Installation of corrosion racks and coupons and monitoring of corrosion rates on MS at 60 days exposure and on Cu at 90 days exposure.
- Daily check of pH, total hardness, m-alkalinity, p-alkalinity, chloride, TDS and conductivity of recirculation water.
- Water balancing by reduction of makeup and blow down water volumes while maintaining cycle of concentration close to 5.
- Tests for total bacterial count and sulfate reducing bacteria's every 3 months.

Benefits to Client

- Reduction in Condenser Tubes Descaling: Every de-scaling operation eats away some of the condenser tube metal thereby reducing the equipment life. Gradual scale build up between 2 consecutive de-scaling operation leads to reduction in heat transfer and increase in energy consumption treatment has significantly reduced de-scaling to only one time in a year and depositions if any observed are very soft and easily removed and thus ensured asset protection.
- Reduction in Energy Conservation: Chillers are the single largest energy using component in most commercial. Typically they consume 40-50% of the total electrical usage. 70% of the chiller efficiency is determined by the effectiveness of water treatment of condenser. A poorly managed water treatment can reduce efficiency by 10 to 35% and increase energy consumption. 1 degree F increase in the condenser temperature increases compressor horsepower by 1.5-2%. Based on our results we have achieved a saving of approx 10, 500 units in three months.
- Water Conservation: Utilization of recycled water (STP treated soft water), less usage of portable water, recirculation of same water at least 5 times thus reduced the overall building water consumption by 10% thus moving towards sustainability.
- Controlled Chemical Dosing: Dosing of chemicals is designed to achieve active



Before Treatment - High Biological Growth

After Treatment - No Biological Growth

chemical constituent at all times. A balance is set between the amount of chemical in the system and its specific dilution.

- Process Efficiency: Increase in cooling tower efficiency and effectiveness. Improved plant performance through effective chemical treatment program.
- Asset Reliability: Increase uptime, less downtime, longer equipment life span.
- Optimization of Available Resource: Less man hours required to clean the chillers tubes and cooling towers.
- Periodical Monitoring through Lab Tests Analysis: Routine monitoring and validation through lab test reports
- Ecological Balance: PER KWH generation of energy emits 0.6 kg of CO2. 10500 units have resulted into reduction of CO2 emission by 6300 kg in three months.
- Environment: All chemicals used in treatment are eco friendly and environmentally biodegradable

Parameter	Ms	Cu
System	AC Cooling Tower	AC Cooling Tower
Coupon No.	217	159
Metallurgy	Ms	Cu
Treatment Program	Scale Inhibitor, Corrosion Inhibitor, Oxidizing and Non Oxidizing Biocide	Scale Inhibitor, Corrosion inhibitor, Oxidizing and Non oxidizing Biocide
Exposure Date	11/05/2015	11/05/2015
Date of Removal	12/08/2015	12/07/2015
No. of Days Exposed	90	60
Initial Weight of Coupon (in gm)	8.556	9.7052
Final Weight of coupon (in gm)	8.47	9.68
Weight Loss in mg	86	25
Corrosion Rate in mpy	0.35	0.1

$$\text{Formula Used} = \frac{(\text{Wt.Loss in mg x are factor of the Coupon})}{(\text{No. of Days Exposed})}$$

Table 1: Corrosion Coupon Test Report

About the Author

Deepak Uppal serves as Executive Director of Vatika Hotels Pvt. Ltd., which is a part of the hugely diversified Vatika Group spanning Commercial and Residential Real Estate, Hotels & Resorts, Restaurants, Business Centers and Integrated Facilities Management.

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