Air Cooled Fluid Coolers

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1000cmh adiabatic cooler at Saint Gobain Glass, Bhiwadi, Rajasthan

Introduction

Climate change is affecting our everyday life in many ways. Environmental issues are rising globally and water is turning out to be the world's most precious resource ever. Water for power generation and process cooling is in great demand.

One typical nuclear power plant in the U.S. uses 30 million gallons of cooling water an hour. The whole city of New York uses 46 million gallons of water an hour, so a single nuclear power plant needs water flow that would support a typical U.S. city of about 5 million people. And the U.S. has 104 nuclear power plants – more than any other country, a quarter of all plants worldwide.

In India, water scarcity has become a big challenge. Water shortage is widespread in almost all states, and water demand for the industrial sector is very high. The situation is getting worse as old techniques and water consuming equipment like cooling towers are still very much in use. At the same time, it is obvious that in the coming years water scarcity will significantly affect the businesses of many industries, including thermal power, engineering, chemicals, textiles, pharmaceutical and cement plants.

Air Cooled Fluid Coolers

For ages, industry has been equating heat dissipation with water consumption. Air Cooled Fluid Cooler (ACFC) is an air cooled heat exchanger wherein any type of fluid can be cooled with the help of ambient air. This technology can be applied to engine cooling, turbine auxiliary cooling, turbine inlet air cooling and process cooling. We have been working on ACFCs and Adiabatic Systems, and have achieved an installation base of more than 50,000 MW of heat dissipation.

Benefits of ACFC

Let us compare ACFC with cooling towers to have a clear picture.

Water Saving

ACFC gives several advantages in comparison to cooling towers. The main advantage is water saving. In ACFC, water consumption is nil as the system has to be filled only once. After that the same

About the Author

Jagjit Singh is Director (Business Development) in International Coil Limited, an ISO 9001-2000 company. He is a B.Sc. and MBA with experience of 3 decades in designing, manufacturing and marketing of heat transfer equipment. He contributed significantly to developing Air Cooled Fluid Cooler (ACFC) Remote Radiator, a device for rejecting heat from fluid/ water directly to the ambient air, which is used in the power, industrial, corporate and real estate sectors, hospitals and airports.

water is circulated in a closed circuit system and is not exposed to the atmosphere, so there is no loss due to evaporation or other factors. On the other hand, cooling towers require continuous supply of water in large quantity. For example, nuclear power plants require 4 to 5 m^3/hr water to produce 1 MW of electricity.

Water Softening

Water softening system is not required in ACFC because the same water is circulated. Hence the cost of water softening plant is eliminated. In case of cooling towers, water softening plant is a must to achieve the desired quality of water as the water source may be a river, canal or sea. The cost of the water softening plant is very high.

Scale Formation

There is no scale formation in an air cooled system as the water filled in the system is already clean and this water is recirculated. Water used in a cooling tower always contains a certain amount of minerals and other foreign materials depending upon its source. Hence scale formation occurs in case of cooling towers.

Maintenance

ACFC requires very little maintenance except yearly routine inspection of electric fan motors. If dirt accumulates at finned surface heat transfer coils in bad weather conditions, it can be easily cleaned. Hence, there is hardly any maintenance cost. Cooling towers require high maintenance cost due to continuous flow of water and scale formation.

Life Span

ACFC has a longer life than a cooling tower, where the damage caused by water itself reduces the life span. In general, the life of ACFC is around 20 years whereas for a cooling tower it is approximately 10 years.

Typical Savings with ACFC

Let us take a typical case of turbine auxiliary cooling (2 x 225 MW GE Turbines + 80 MW STG), at a flow rate 1140 m^3/hr and temperature difference of 9°C *(see Table 1)*.

Table 1: Typical saving with ACFC compared to cooling tower

S. No.	Quantum	Units	Details	Remarks
1	1140	m^3/hr	Water flow rate	
2	34.2	m^3/hr	Cooling tower make up water required	
3	0.00	m^3/hr	Water consumption with ACFC	
4	34.2	m^3/hr	Water saving with ACFC	
5	6,84,000	lt/day	Water saving per day (20 hrs/day)	
6	24,96,60,000	lt/year	Water saving per year	
7	1,99,72,800	Rs./ year	Water cost saving per year (Rs. 0.08 per litre)	A
8	36	kW	Power consumption in case of CT	
9	125	kW	Power consumption with ACFC (with VFD)	
10	32,48,500	INR	Additional power cost with ACFC (20 hrs/ day @ Rs 4 per unit)	B
11	5,00,000	INR	Maintenance cost with CT	C
12	1,72,24,300	INR	Total running cost saving with coil cooler	A+C-B

Adiabatic Coolers

Many process cooling application like casting plant, weld shop, paint shop, air compressors, chiller condensers, furnace cooling, etc. require water to be cooled lower than ambient temperature. With growing water scarcity, we have innovated a product called Air Cooled Adiabatic Cooler, which can cool process water below ambient temperature. Adiabatic cooler is used to cool process fluid with ambient air. It is also known as a hybrid cooler, since it works as a combination of dry and wet cooler. During high ambient temperatures it automatically switches to wet mode, and when ambient is low or favourable it works in dry mode. Compared to a cooling tower system it saves a substantial amount of water. The design criterion is to cool process water or fluid in the tubes to about 5°C approach of ambient wet bulb temperature.

The adiabatic concept is based on intermittently and efficiently evaporating water on a large mesh area in front of the heat rejection surface. It acts as an evaporative air inlet cooling unit for the Air Cooled Fluid Cooler. Its ecomesh uses non-metallic wired mesh panels, and the adiabatic cooling effect is created through an intermittent water spray over the wired mesh surface (not on the ACFC). Ecomesh system is used in processes where the process water requirement is less than the ambient temperature.

The adiabatic system is an air cooled heat exchanger, which rejects heat from a process cooling medium to the surrounding atmosphere by means of dry cooling i.e. convective heat transfer or wet cooling. The operating mode is dependent mainly upon the heat load and ambient conditions.

The process cooling medium, generally water or a water-glycol mixture, flows inside the horizontal tubes of finned tube

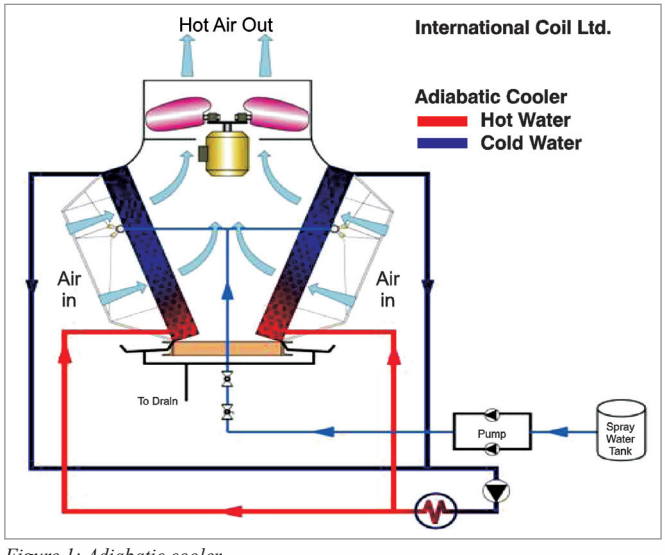

Figure 1: Adiabatic cooler

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heat exchanger bundles arranged in a V-shape or vertical configuration. Water inside the tubes is cooled by the ambient air being sucked by fans on the top of air cooler *(see Figure 1)*.

Some of our major orders for adiabatic coolers are:

1) More than 100 adiabatic cooler installations at Maruti Suzuki.
2) Repeat orders from Saint Gobain for Bhiwadi expansion project.
3) Sole supplier against global competition for ACFCs from Hindustan Zinc, Udaipur.
4) Gas engine charge air cooling circuit development orders from GE, Cummins, MWM and CAT.
5) VAM and centrifugal chiller condenser cooling for Broad and Trane chillers. ❖

Figure 2: World's largest adiabatic cooler installation at Hindustan Zinc, Udaipur

Figure 3: Adiabatic cooler being installed at Hindustan Zinc, Udaipur