Steam Gas Plant Reducing Circulating Water Waste in Water Cooling Towers

Qobilbek Dadaboyev[1,2] and Bakhtiyar Yunusov[1]
[1]*Tashkent State Technical University, Universitet Str. 2, Tashkent, Uzbekistan*
[2]*University of Tashkent for Applied Sciences, Gavhar Str. 1, Tashkent, Uzbekistan*
qobilbekturacity@gmail.com, elyor.saitov@mail.ru

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Abstract: This work is devoted to the calculation of the cooling tower. The explanatory note reflects the material, thermal, hydraulic calculations, guided by which it is possible to select the type of apparatus and its design dimensions. The temperature diagram of the process, the technological diagram of the process, the structural diagram of the apparatus, sketches of the main elements of the apparatus are also shown. The field of velocities of the gas phase, the movement of solid particles, the kinetics of disaggregation of lumps of material, the effect of the concentration of the inert packing and the swirl angle of the coolant on the kinetics of disaggregation of the coolant, was studied experimentally and the choice of the type of inert substance and its concentration was determined. With the help of these techniques how much technical water is saved is also given. In addition, the kinetics of material drying was studied taking into account its disaggregation in a swirling coolant flow.

1 INTRODUCTION

Water cooling in industry Industrial water supply systems are designed to supply production with water in the required quantity and appropriate quality [1]. They consist of water intakes, pumping stations, interconnected structures of water conduits, water quality treatment and improvement facilities, control and storage tanks, water coolers, and distribution pipelines [2]. Water is stored for reuse after cooling and (or) cleaning. Such water is called recycled or circulating. Depending on the type of technological process, it can be a circulating water transport or absorbing medium (the use of water of such qualities is not taken into account in this work) or a circulating heat carrier in the cooling system of the circulating water supply [3]. It is a system in which water is used as a refrigerant to cool equipment or to condense and cool gaseous and liquid products in heat exchangers, which are heated and in some cases contaminated with these products, mainly due to leaks in water pipes. Basically, after cooling and cleaning (if necessary) in cooling towers, the main part of the water is returned to the system; a part of the processed water (usually no more than 5%) is lost to the effluent in the form of evaporation, droplet penetration, leakage and system bursting. In the world, recycled cooling water is used to cool various types of technological equipment, which is about 65% of the total water consumption of this category on average for all industries. and is determined by the operational characteristics of the equipment. When choosing the type of cooling towers to ensure this temperature, it is necessary to take into account the possibility of water contamination with production products in the water cycle. Heat and power industry enterprises consume two-thirds of fresh water from water supply sources for industrial needs, and the largest consumption is for cooling technological equipment (96%). At the same time, the water turnover ratio in the industry is lower than the average for the industry and is approximately is 60%. In industry and energy, water is used to condense and cool gaseous and liquid products [4].

Water cooling tower – serves to lower the temperature of "Technical water" participating in the process of condensation in the cooling system along the general cycle and after returning from the cycle. It removes heat from circulating water with a temperature of 26-28 ^{0}C and transfers this heat to the incoming air flow, as a result, it provides the cooling system with technical water with a constant temperature of 16-18 ^{0}C.If we look at the world experience, it seems that there are different styles in the technical water cooling system; with outdoor pool, spray pool and cooling tower. Among these methods, the most optimal choice from the economic and environmental point of view is the cooling tower method, because it does not require a large area like the other methods, and the water cooling capacity and quantity are large, and the work efficiency is high. Therefore, in recent years, countries around the world have been using only the cooling tower method [5]. Now let's look at the technical parameters of the air-foil cooling tower from the beginning. The top of the radiator block has circular air intake fins that pull up the warm air below. 2 of these tunnels serve a total of 22 tunnels, 11 of them for a steam gas unit with a capacity of 450 mw [6].

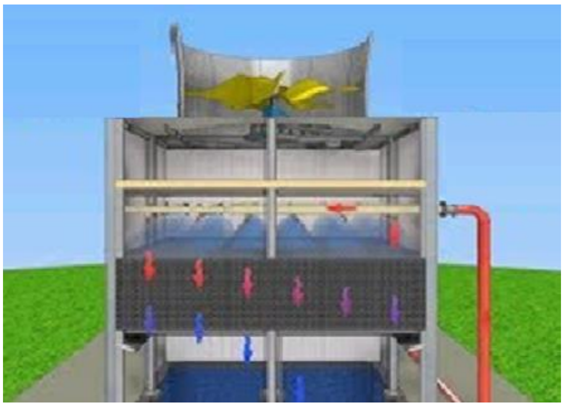

Figure 1: Water cooling tower.

The power of the engine turning the blades is 199 kW/h, Voltage- 400 V the shaft that transmits rotational movement from the engine is 159 mm.

The hot water coming from the common system is transferred through pipes to the sprinklers in the inner, upper (lower than the wings) part of the greenhouse. Sprayers spray hot water on the rust in the form of a drop (spray) [7]. Sprayed hot water droplets hit *the apacume l* and spread downwards. At the bottom of the terrace there is a water pool where the cooled water is stored. Cold water is sent back to the system through supply pumps and circulation continues.

2 METHODS AND MATERIALS

This research work differs from the works in the literature mentioned above. Two identical mono c-Si PV modules were used in the experiment. The electric power of PV modules is 15W and consists of 36 SC. The PV modules are mounted on a support device that has a two-axis twist at the same angle. The base device also has a place for measuring instruments (Figure 2) [8].

Water from the outside pipe is distributed to each distribution pipe and then to the sprinklers.
Distribution pipe material - FRP (Fiberglass).The Figure 2 shows a typical water cycle around a cooling tower. They receive circulating water cooled through these heat exchangers. During this process, heat is absorbed into the circulating water and returned to the cooling tower for cooling. This process is continuous while the station is running. Make-up water is supplied to the cooling tower pool to compensate for evaporation losses, displacement losses, etc.

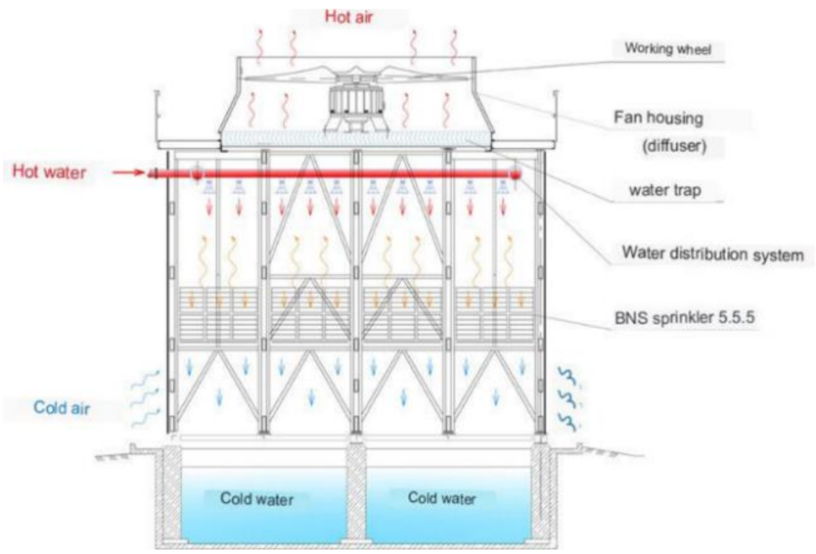

Figure 2: Mode of operation of the water cooling tower.

A bypass line is used in the winter season [9]. A water cooling tower can lose 2% of the water it cools during operation. For example, if a cooling tower that cools 35,000 m^3 of water per hour wastes 700 m^3 hour of water, it becomes 16,800 m^3 per day. Since this is definitely chemically purified, processed water, its price is quite high. Let's take a look at exactly where this waste of water is taking place. The hot water coming from the system to the water cooling tower is sprayed downwards from the nozzles of the tower (Figure 2), and the air fins suck the air up, as a result, the hot water particles sprayed from the nozzles fall on the arasitel and begin to flow downward [10]. The upward movement of air and the downward movement of water along the air duct creates a mutual heat exchange process, and the air takes the heat of the water and goes out into the atmosphere through the ventilator. At first glance, everything is normal, because the goal has been achieved, the temperature of the production technical water has decreased, but during this process, a part of the water that has not yet reached the surface is released into the atmosphere with the hot air due to the force of the air flow. Of course, water catchers are installed under the wings, which will catch some of the water droplets, but to catch more water, we need a different technology. We have concluded from our research that to reduce this wastage, wrapping stepped catchment panels around the tower will reduce wastage to a certain extent.

Step water catchment device, first of all, let's take a good look at the problem before us.

3 RESULTS AND DISCUSSION

Technical water lost in the cooling tower is lost in the form of water vapor and water particles. We now aim to reduce the wastage of water particles rather than water vapor retention. Because trapping water vapor has some complications. The waste of water particles can be reduced by technical methods. To do this, we need to install water-catching steps on the upper part of the ventilator, which do not block the air flow, but catch water particles. This device of ours should be such that it traps water particles and eats them together, but does not prevent the air from escaping. The water trap with steps that we recommend has the same capabilities as the steps. This device is installed tightly on the top of the ventilator [11].

Installation of a step water catchment structure. Our recommended step water trap must meet several requirements.

1) The performance of the device justifies itself.
2) It should have a soda texture as much as possible.
3) Not requiring energy in working condition.
4) Resistance to mechanical deformation.
5) Chemical corrosion resistance.
6) Do not disturb the air outlet so as not to stress the fan motor.

For emergency situations, the on son can be released and separated into pieces. Of course, there is a risk that salt particles will collect and form slag layers between the steps. Therefore, it can be released for cleaning purposes [12].

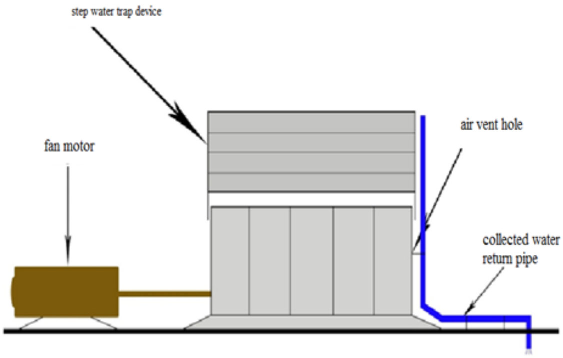

Figure 3: Installation of the device.

Now we will approach each requirement separately.

Step water catchment device is reminiscent of gas turbine blades (Figure 3). That is, it consists of panels with a special water catchment channel consisting of 4 steps.

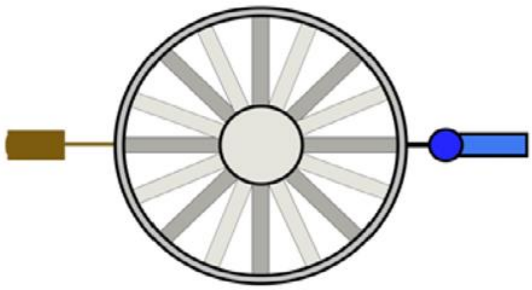

Figure 4: Top view of a stepped water trap.

Is 970 cm, corresponding to the diameter of the ventilation hole. Correspondingly to the dome of the tunnel, the contact block is bricked with 8 fixing bolts of the panel water channel so to structure the owner she is slip coming the water internal channel across skip sends. O is fixed water particles collect and move along the channel. Because the panels are installed at a 30^o slope along the center of the circle. Then the water collected in the water channel begins to flow towards the edge of the circle (Figure 4). The water moving along the water channel goes around the edge of the panels to the bricked water pipe. Through the central water return pipe, water is poured into the cooling tower water supply. The efficiency of water heaters depends on the speed of air ώ flow and the density of water particles $q_{w.}$ We can express this relation as follows:

$$q_v=3{,}44\cdot 10^{-5} q_{tv}\, q_w^{x} ώ^{y}$$

or to simplify, on the basis of legitimacy

$$q_v={}^5 q_{tv}\, (q_w ώ/14{,}57)^{y},$$

here q_{tv} -table values, q_v at ώ= 2,35 m/s va q_w=6,2m^3 /(m^2·h) [13] the performance of water catchers is not universal for any amount of air speed. In addition, the granulomere composition of water particles in the air greatly affects the performance.

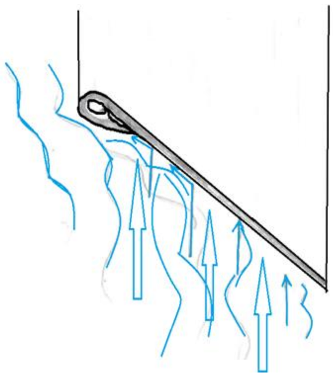

Figure 5: Cross-sectional surface of the panel.

The panels of our device have such a structure that it is installed under a special slope of 70^o, and after the water particles hit the surface of the panel, they move up along the panel due to the air flow and flow into the special water channel at the top of the panel and move along the water channel (Figure 5 and Figure 6).

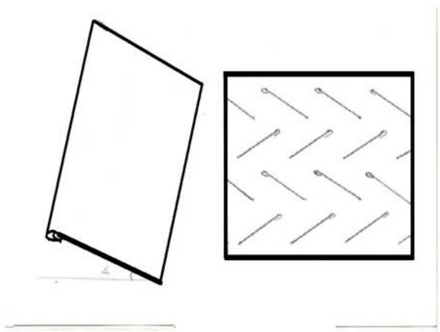

Figure 6: Panels step mothers across location.

And the air flow continues to slide up along the upper part of the channel without entering the channel due to the almond-shaped structure at the entrance of the channel, and after 4 steps, it goes out into the atmosphere (Figure 7).

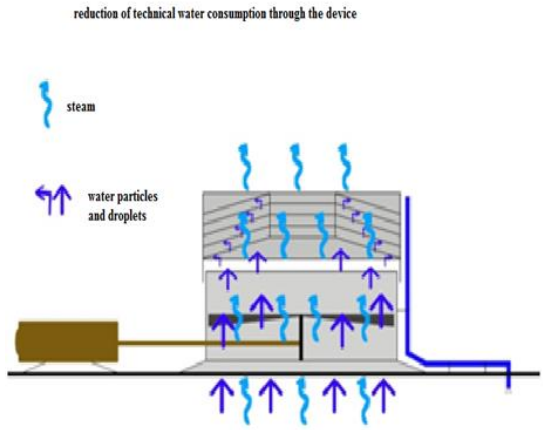

Figure 7: Water retention in the device.

There are 16 panels parallel to each other in the horizontal direction, and 4 steps in a zig-zag pattern in the vertical direction. The total number of panels reaches 64 in one device.

4 CONCLUSIONS

Then it becomes possible to hold more water particles in the air stream [14-16].

Our device now only captures water particles. And the water vapor goes out into the atmosphere with the air flow. Our device must be made of corrosion-resistant material, as it will work with constant water. There are many types of such materials today, but the most economically optimal choice is FRP (glass fiber reinforced concrete) cooling pipes. In addition, FRP is mechanically as strong as steel due to its high inter-lattice uniformity. The price is not expensive, that is, it is cheaper than steel. If we install a total of 22 such devices for a common cooling tower, we will catch 65-70% of the lost technical water particles and droplets. That is, 50% of the total loss of 600 m^3/h is steam, 50% is in the form of water particles and drops, and 300 m^3 is in the form of water particles and drops. 65 % of technical water retained is 195 m^3. If we put it in money, the amount saved every hour is 8,775,000. The amount lost per hour was 27,000,000. This is 32.5% of the total amount.This means 32.5% of the waste lost through the vent hole. If this device is introduced in our production, our device will definitely justify its cost and the station will achieve more economic efficiency.

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