

A STUDY ON AIRWASHER SYSTEM AND ITS APPLICATIONS

SARAVANAN.D¹

¹Lecturer, Dept of Mechanical Engineering(R&A/C)
Valivalam Desikar Polytechnic College Nagapattinam.

Abstract – Airwasher is one of the air conditioning equipment used for industrial cooling so that the humidity and temperature can be maintained for comfort or process requirements in industries. This article presents the construction, working, psychrometric processes involved and its applications in industries

Key Words: Air washer, Humidity, Psychrometric process, Spray nozzle, DBT, WBT, DPT

1. INTRODUCTION

The air conditioning field is one of the increasingly important for both human comfort and industrial applications. Controlled humidity and temperature requirements are of vital one in industries such as textile industry, printing industry etc. The use of air washer fulfills the humidity and temperature needs for the process industries. The air washer cleans, humidify or dehumidify the air depending upon the requirements. The cleaning of air includes the removal of air borne impurities such as dust, smoke and fumes. Humidifying means the increase of water vapour in the air whereas dehumidifying means removal of water vapour from the air.

2. AIR WASHER CONSTRUCTION

The main components of air washer are an insulated water tank, pump, pipes and fitting, main chamber, blower casing, water spray nozzles, filter and blower motor. The insulated water tank is located at the bottom of the air washer. The blower is used to draw the atmospheric air into the air washer main chamber. Proper pipeline arrangements ensure to deliver the water from the water tank to the spray nozzles attached at the pipe header. The pump supplies water from the tank to the spray nozzles at the required pressure.

3. AIR WASHER WORKING

The line diagram of air washer is shown in Fig-1. A constant level of water is maintained in the water tank located in the bottom of the air washer by providing make-up water provision. The pump pumps the water in a required pressure passes through cooler cum heater arrangement and finally to the spray nozzles fitted in the header pipe. The blower which is run by an electric motor sucks the ambient air and admitted into the main chamber through a filter. The filtered air mix up with the spray water in the main chamber where heat exchange and mass exchange takes place. Also, some

mass of water vapour added to the air. Then the conditioned air leaves out the air washer through an eliminators and sent to the space where the conditioned air is needed.

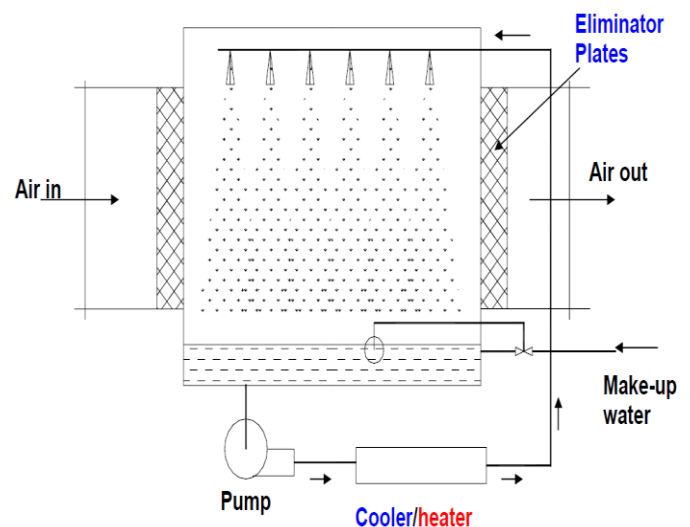


Fig-1: Line diagram of air washer

4. AIR WASHER WORKING AS HUMIDIFIER

Humidification is the psychrometric process of addition of water vapour to the air. The air washer can be used as humidifier if the DBT and WBT of the incoming air should be equal to the spray water temperature. At this condition no dehumidification takes place because the spray water temperature is above the DPT of entering air into the air washer main chamber.

5. AIR WASHER WORKING AS DEHUMIDIFIER

Dehumidification is psychrometric process of removal of water vapour from the air. The dehumidification is achieved in the air washer by maintaining the spray water temperature well below the DPT of entering air into the main chamber. During this process in addition to dehumidification cooling also done on the air. Sometimes if the temperature of leaving air is below the required space temperature, then the air can be heated using a heating coil at the outlet of the air washer to bring the air temperature to the required space temperature.

6. PSYCHROMETRIC PROCESSES IN AIR WASHER

The following psychrometric processes can be achieved using air washer

- ❖ Heating and humidification
- ❖ Humidification
- ❖ Cooling and humidification
- ❖ Adiabatic saturation
- ❖ Cooling
- ❖ Cooling and dehumidification

6.1. HEATING AND HUMIDIFICATION

During this process air is heated and humidified. To achieve this process the temperature of spray water (t_s) must be greater than the DBT(t_1) of entering air. So hot water above the temperature of entering air must be sprayed in the main chamber through the spray nozzles. By doing so the air leaving the air washer is humidified and heated. This process is represented by a line 1-2A in the psychrometric chart shown in Fig-2.

6.2. HUMIDIFICATION

During this process air is humidified. To achieve this process the temperature of spray water (t_s) must be equal to DBT (t_1) of entering air. So, the temperature of spray water equal to the temperature of entering air must be sprayed in the main chamber through the spray nozzles. By doing so the air leaving the air washer is humidified. This process is represented by a line 1-2B in the psychrometric chart shown in Fig-2.

6.3. COOLING AND HUMIDIFICATION

During this process air is cooled and humidified. To achieve this process the spray water temperature(t_s) should be less than DBT(t_1) of entering air and greater than WBT(t'_1) of entering air. So, water in the tank is kept below the temperature of entering air and above the WBT of entering air is pumped and sprayed through the spray nozzles to the main chamber of the air washer. The air entering into the air washer main chamber mixes with the spray water and gets cooled and humidified due to heat and mass exchange between air and water. This process is represented by a line 1-2C in the psychrometric chart shown in Fig-2.

6.4. ADIABATIC SATURATION

During this process air is adiabatically saturated. To achieve this process the spray water temperature(t_s) should be equal to WBT(t'_1) of entering air. So, the water in the tank is

recirculated again and again without any external heating or cooling. This process is represented by a line 1-2D in the psychrometric chart shown in Fig-2.

6.5. COOLING

During this process air is cooled. To achieve this process the temperature of spray water (t_s) should be equal to the dew point temperature DPT (t_d). So, the temperature of water from the tank is required to be cooled and sprayed through the spray nozzle through the air chamber where the entering air mixes with the spray water and gets cooled and leaves from the air washer to the space where cooling is required. This process is represented by a line 1-2F in the psychrometric chart shown in Fig-2.

6.6. COOLING AND DEHUMIDIFICATION

During this process air is cooled and dehumidified.

During this process air is heated and humidified. To achieve this process the temperature of spray water (t_s) must be less than the DPT (t_d) of entering air. So, cold water below the DPT of entering air must be sprayed in the main chamber through the spray nozzles. The air entering into the air washer main chamber mixes with the spray water and gets cooled and dehumidified due to heat and mass exchange between air and water. The water vapour present in the air is removed due to dehumidification. The cooled and dehumidified air leaves the air washer and enters into the space where it is needed. This process is represented by a line 1-2G in the psychrometric chart shown in Fig-2.

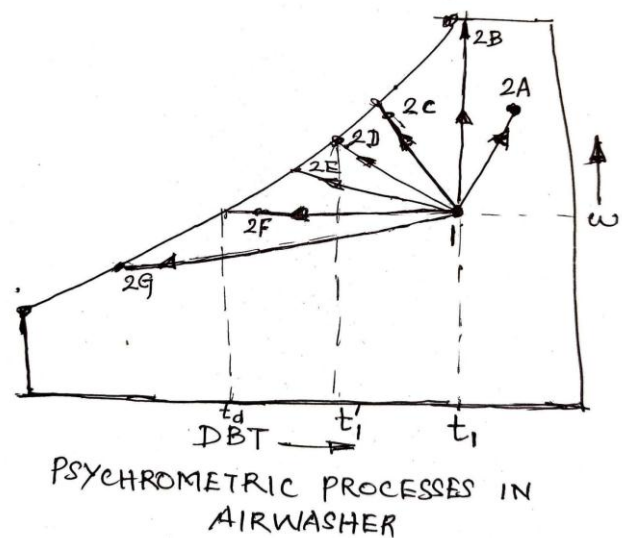


Fig-2: Various psychrometric process representation in skeleton psychrometric chart

7. APPLICATIONS OF AIR WASHER

- ❖ Comfort air conditioning requirement for hotels, malls, industrial units etc.,
- ❖ Industrial process application in textile, printing, packing industries etc.,
- ❖ Compressor and gas turbine pre-cooling applications
- ❖ Applications where 100% fresh air requirements
- ❖ Application in areas where dust free needs

8. CONCLUSIONS

This paper is concluded with

- ❖ A detailed study was made on the construction and working of air washer, its working as humidifier, dehumidifier, cooler and air purifier.
- ❖ Depending upon the space requirements, the spray water temperature can be varied and the desirable indoor conditions can be achieved.
- ❖ Air washers is one of the best air conditioning equipment which provides various conditions of air using a single equipment.

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BIOGRAPHIES



D. SARAVANAN M.E.,

Teaching profession in Mechanical Engineering for past 20 years.