Oil Hydraulics and Pneumatics
Prof. Somashekhar S
Department of Mechanical Engineering
Indian Institute of Technology, Madras

Part 01: Need for Air Dryers, Analysis of Moisture Removal from Air, Typical Air Drying Methods, Basic Types of Air Dryers
Lecture – 30
Air Dryers

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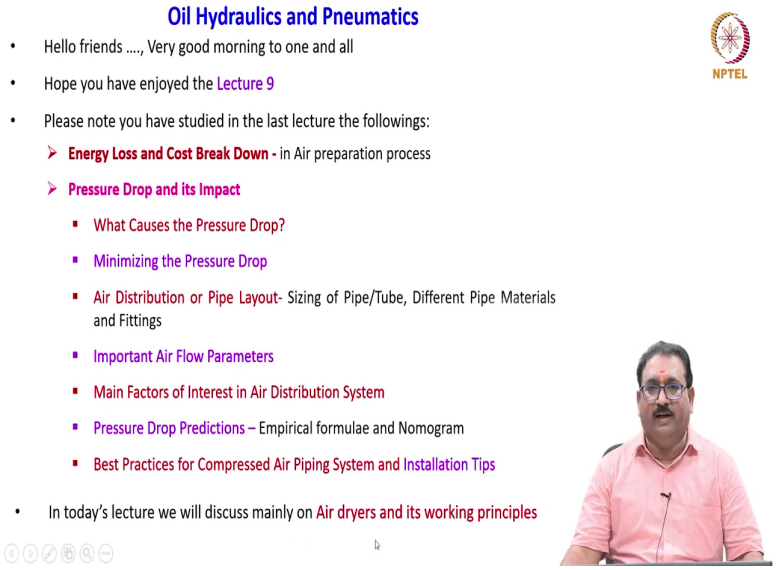

My name is Somashekhar, course faculty for this course. Hello friends, very good morning to one and all, hope you have enjoyed the lecture 9. Please note, you have studied in the last lecture the followings; energy loss and cost break down in air preparation process, pressure drop and its impact. Under this heading we have discussed; what causes the pressure drop, minimizing the pressure drop, air distribution or a pipe layout. Here we discussed sizing of pipe, tube, different pipe materials and fittings.

Important air flow parameters, main parameters of interest in distribution system; pressure drop prediction using the empirical formulae and Nomogram; also we discussed the best practices for compressed air piping system and installation tips. In today's lecture, we will discuss mainly on Air Dryers and its working principles.

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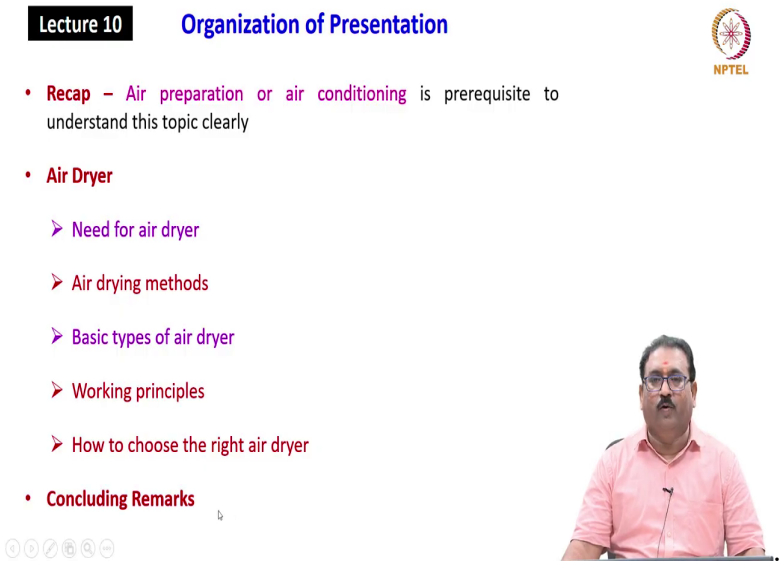

We will move on to organization of today's lecture presentation, includes quickly recap; air preparation or air conditioning is a prerequisite to understand this topic clearly. Then we will move on to air dryers; here will discuss need for air dryer, air drying methods, basic types of air dryers, working principles, how to choose the right air dryer for industrial applications, concluding remarks.

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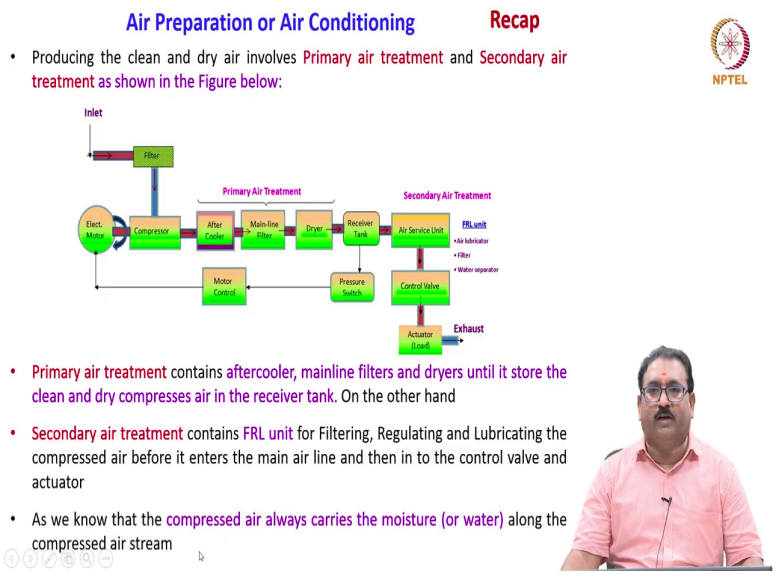

Already we have studied in the last lectures, air preparation and air conditioning is one of the important requirement to get clean and dry air. Objective is here, producing the clean and dry air involves the primary air treatment and secondary air treatment as shown in the figure below, correct friends. This is a compressor, which will sucks the air and compresses the air into the required pressure; then air will exit from the compressor and passes through the air conditioning steps.

Primary air treatment, secondary air treatment; the primary air treatment contains aftercooler, mainline filter and dryers until it stores the clean and dry air in the receiver tank. On the other hand, secondary air treatment contains the FRL unit; what is known as air service unit used for filtering, regulating and lubricating the compressed air before it enters the main airline and

then to the control valves and actuator. As we know that the compressed air always carries the moisture along with the compressed air.

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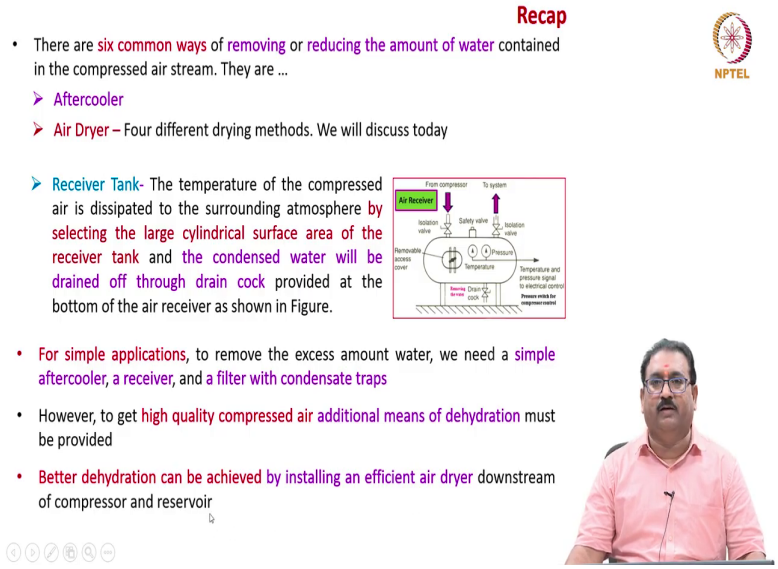

So, there are six common ways of removing or reducing the amount of water contained in the compressed air stream. Then what are those? Aftercooler, air dryer; four different drying methods are there, we will discuss in the todays class.

Receiver tank also do the function of lowering the air temperature; that is why we know that, the constructional features of the air receiver tank is always a cylindrical large surface area to dissipate the heat. The moisture dissipated, collected in the receiver tank at the bottom. So, it should be drained through the drain cock. Also we know that, hot air is not allowed here; that is why air deceiver also dissipates the heat.

Then dry and clean air always you will take it from the top side; we have discussed already these things. For simple applications, to remove the excess amount of water, we need simple aftercooler, a receiver and a filter with condensate traps. However, to get high quality compressed air, additional means of dehydration must be provided. Better dehydration can be achieved by installing an efficient air dryer downstream of compressor and reservoir.

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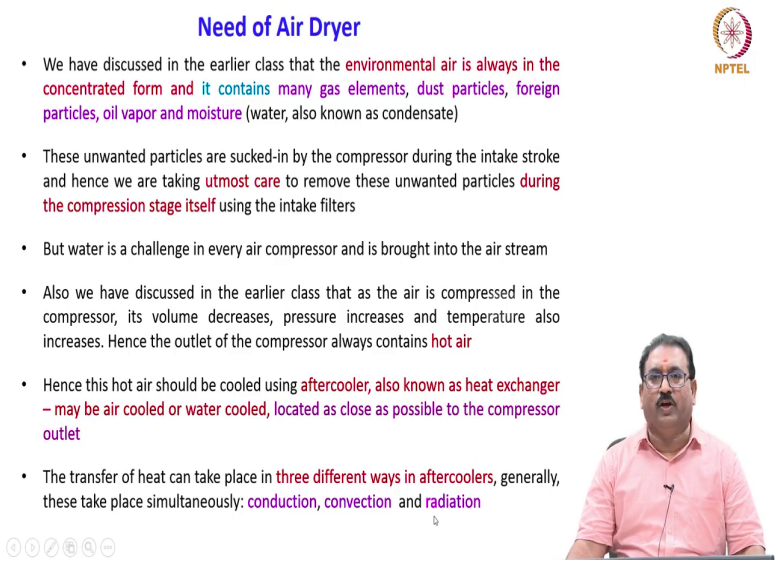

Then question arises, apart from the reducing the moisture; what are the other functions air dryers will do? Even though reducing the water content is a main criteria for the air dryer. We have discussed in the earlier class that, the environmental air always in the concentrated form and it contains many gas elements, dust particles, foreign particles, oil vapor and moisture; the moisture also known as a condensate.

These unwanted particles are sucked in by the compressor during the intake stroke along with this moisture. And hence, we are taking utmost care to remove these unwanted particles during the compression stage itself using the intake filters. But water is a challenge in every air compressor and is brought into the air stream.

Also we have discussed in the earlier class that, the air is compressed in the compressor; what happen, its volume decreases, pressure increases, and temperature also increases. Hence, the outlet of the compressor always contains the hot air. Hence this hot air should be cooled using aftercooler.

These are also known as heat exchanger, may be air cooled or water cooled, located as close as possible to the compressor outlet. The transfer of heat can take place in three different ways in aftercooler, generally, this takes place simultaneously; conduction, convection, and radiation.

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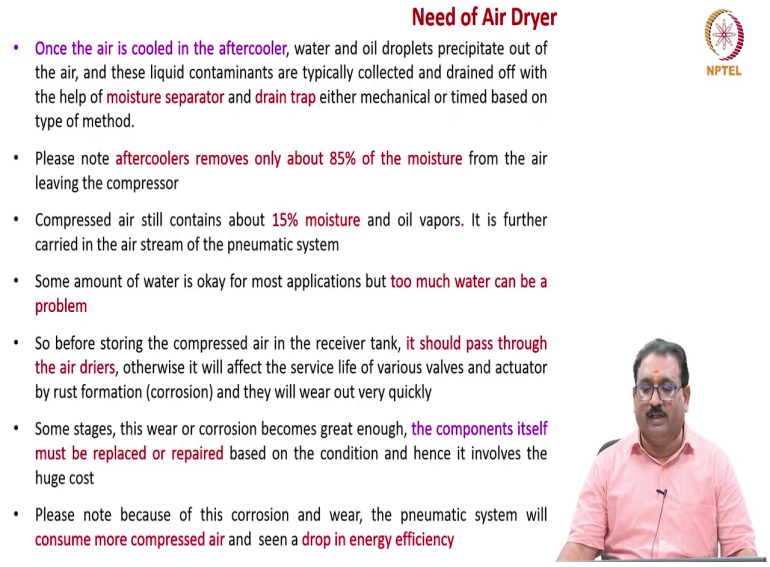

Once the air is cooled in the aftercooler, what happen; water and oil droplets precipitate out of the air and these liquid contaminants are typically collected and drained off with the help of moisture separator and drain trap either mechanically or time based on the type of method used.

Please note friends, aftercooler removes only 85 percent of the moisture from the air leaving the compressor. Compressed air still contains about 15 percent of the water along with oil vapors. It further carried in the air stream of the pneumatic system.

Some amount of water is for most applications, but too much water can be a problem. So, before storing the compressed air in the receiver tank, it should pass through the air driers;

otherwise it will affect the service light life of the various valves and actuators by rust formation and hence what happen, they will wear out during their operations.

Some stages, the wear or corrosion becomes great enough; the compress the components itself must be replaced or repaired based on the condition and hence it involves the huge cost. Please note, because of this corrosion and wear, the pneumatic system will consume more compressed air and seen a drop in energy efficiency; that is why we have to use the air dryer during the air preparation.

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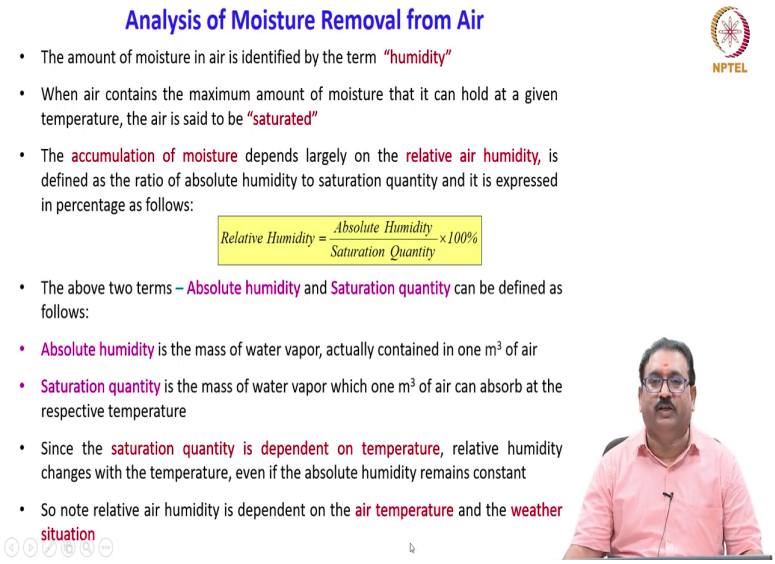

Then we will see the analysis of moisture removal from the air. The amount of moisture in air is identified by the term humidity. When air contains a maximum amount of moisture that it can hold at a given temperature, the air is said to be saturated. The accumulation of moisture

depends largely on the relative air humidity, is defined as the ratio of absolute humidity to saturation quantity and it is expressed as percentage as follows.

This relative humility, absolute humidity, saturation quantity these you have studied in great details in thermodynamic course. But quickly I will give you some of the light on the absolute humidity and saturation quantity, which is required for relative humidity.

The above two terms absolute humidity and saturation quantity can be defined as; absolute humidity is the mass of water vapor, actually contained in one m cube of air. While the saturation quantity is the mass of water vapor which one m cube of air can absorb at the respective temperature.

Since the saturation quantity here is dependent on the temperature. So, the relative humidity changes with temperature, even if the absolute humidity remains constant. So, note, relative humidity is dependent on the air temperature and the weathers situation.

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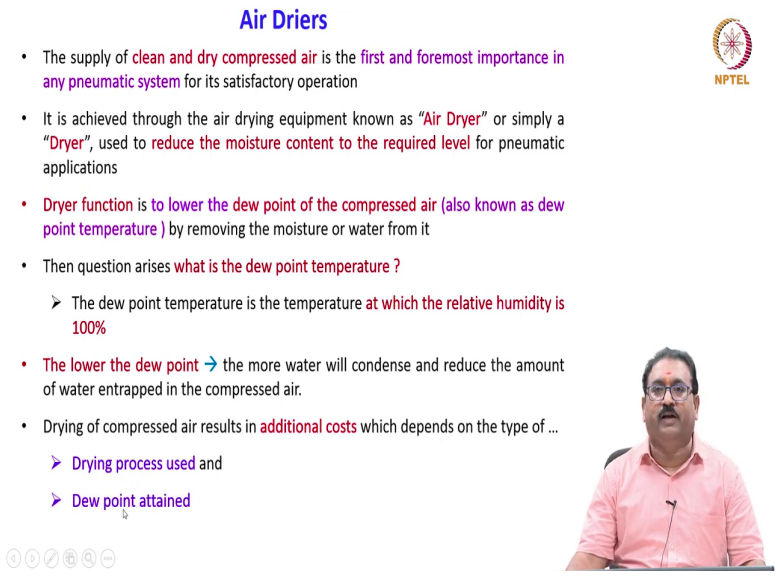

The whole objective is to reduce the water content in the compressed air, for that we are using the air driers. The supply of clean and dry compressed air is the first and foremost important in any pneumatic system for its satisfactory operation.

So, it is achieved through the air drying equipment known as air dryer or simply a dryer, used to reduce the moisture content to the required level for the pneumatic applications. So, dryer function is to lower the dew point of the compressed air; it is also known as the dew point temperature. How to do this? By removing the moisture or water from it.

Then question arises, what is this dew point temperature? The dew point temperature is the temperature at which the relative humidity is 100 percent. The lower the dew point, the more water will condense and reduce the amount of water entrapped in the compressed air. Drying

of compressed air results in additional costs which depends on the type of drying process used and dew point attained.

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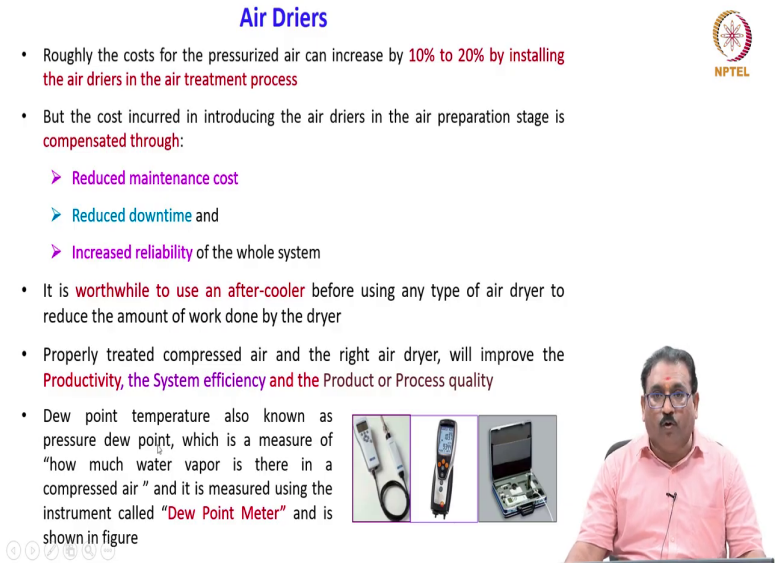

Roughly the cost of the pressurized air can increase by 10 percent to 20 percent by installing the air driers in the air treatment. But the cost incurred in introducing the air driers in the air preparation stage is compensated through; reduced maintenance also reduced cost and reduced downtime. You will see here there are the many advantages by incorporating the air driers reduced maintenance cost, reduced downtime, increased reliability of the whole system is ensured.

It is worthwhile to use an aftercooler before using any type of air dryer to reduce the amount of work done by the dryer. Properly treated compressed air and the right air dryer, will improve the productivity, the system efficiency and the product or process quality.

This dew point temperature also known as pressure dew point, which is a measure of how much water vapor is there in the compressed air and it is measured using the instrument called the dew point meter, which is shown in figure here. This is used to measure the dew point temperature of the air.

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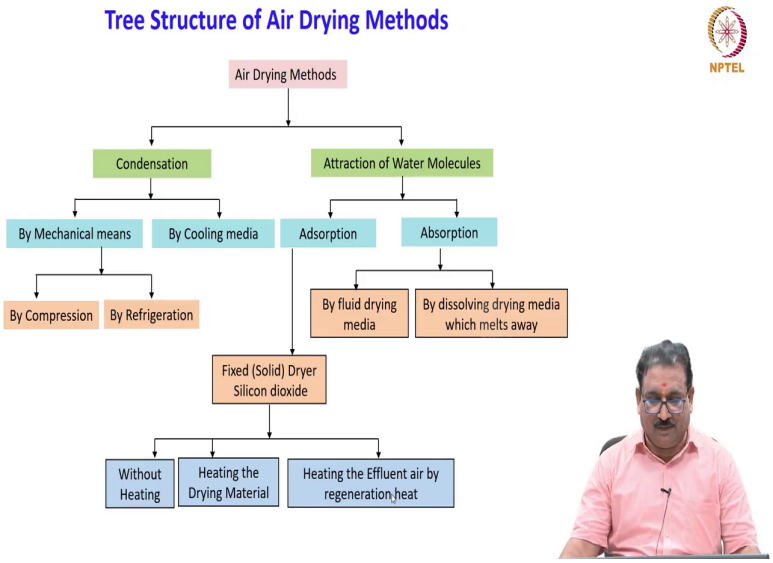

Quickly we will see the there are different air drying methods are there, we will see the tree structure. Air drying methods are classified based on the how you are removing the water from the compressed air, condensation process or attraction of water molecules; in condensation, by mechanical means or by cooling media; in attraction of water molecules, adsorption and absorption principle.

Mechanical means, by compression or by refrigeration; in adsorption, fixed dryer silicon dioxide; in adsorption, by fluid carrying media, by dissolving the drying media which melts

away; in the fixed dryer, without heating, heating with drying materials, heating the effluent air by regeneration heat. Let us we will see some of the things in the next slides.

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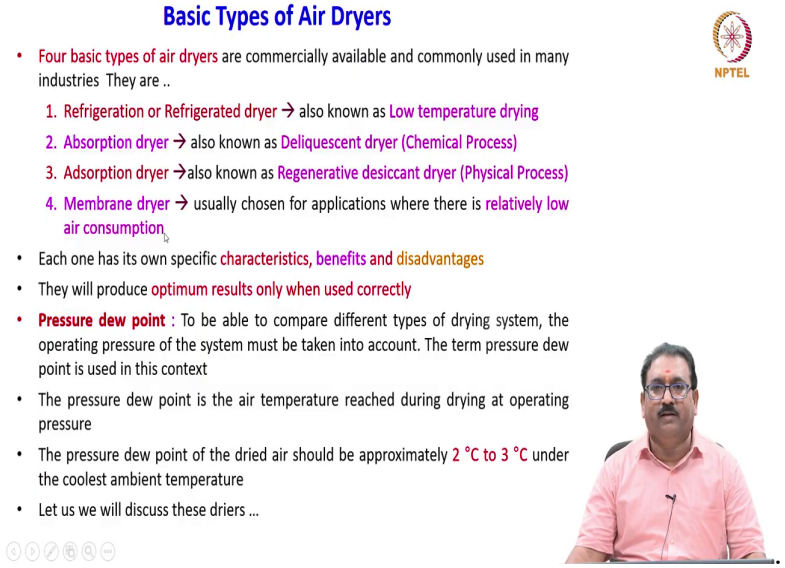

We will move on to the basic types of air dryers. Four basic types of air dryers are commercially available and commonly used in many industries. They are refrigeration or refrigerated dryer; it is also known as low temperature drying. Second one is absorption dryer also known as deliquescent dryer, it is a chemical process. Third one is adsorption dryer also known as regenerative desiccant dryer, which is a physical process of removing the water.

Fourth one is a membrane dryer, usually chosen for application where there is relatively low air consumption. Each one has its own specific characteristics, benefits and disadvantages. They will produce optimum results only when used correctly. Regarding the pressure dew

point; to be able to compare different types of drying system, the operating pressure of the system must be taken into account. The term pressure dew point is used in this context.

The pressure dew point is the air temperature reached during drying at operating pressure. This will varies from one process to another process. The pressure dew point of the dry air should be approximately 2 degree centigrade to 3 degree centigrade under the coolest ambient temperature. Let us we will discuss that these type of driers.