# BEST WORKING CONDITIONS OF DRYING PAPER PROCESS

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**Abstract:** Within the present paper, a diagram of the wet air (Moliere) is done for a certain working sketch and various working conditions. Thus, the wet air condition (dew point) is determined at the paper machine outlet. Conclusions are drawn concerning the value of the specific thermal energy consumption.

**Keywords**: Dew point, drying process, specific consumption

## 1. INFLUENCE OF AIR DEW POINT TEMPERATURE ON THE OPTIMAL DRYING PROCESS

The drying section of a paper machine (groups of dryers) is closed in a hood aiming to create better drying conditions. It is important that air inside the hood to have certain parameters (moisture content, temperature, pressure, etc) in order to allow best drying conditions. Firstly, it should allow water transfer continuously from paper web to air (the air should not be saturated with moisture). A certain value of air dew point temperature determinates in a directly way a minim value of specific heat consumption. To find this value we will calculate for the beginning heat specific consumption without taking into account lost energy (heat consumption/kg evacuated water). Lost energy (heat) will be calculated separately.

Calculus of specific consumptions. Table 1.

| $t_{DP}$ $^oC$ | $t_0$ $^oC$ | $(\Delta h/\Delta x)_1$ kJ/kg |
|---|---|---|
| 50 | 71 | 3289 |
| 52 | 73 | 3233 |
| 54 | 75 | 3182 |
| 56 | 78 | 3143 |
| 58 | 80 | 3106 |
| 60 | 82 | 3074 |

In a first stage (fig.1), heat consumption ($\Delta h/\Delta x$) is calculated without considering heat recovery. So, the entire airflow is introduced at $25^0$C. It considered this airflow with humidity x=0,051kg/kg and relative humidity $\varphi$= 0,7.

Geometric place of evacuated air flow temperature $t_0$ is on the Moliere diagram line A (fig.2). When the heat exchanger air-air (fig.1) works the result is a specific consumption diminishing (tab.1) due to air heating in heat exchanger "1". For the heat exchanger efficiency $\acute{\eta}$= 0,68 can be calculated air temperatures in heat exchanger "1" for different dew point temperature values of evacuated air. The example is given for dew point temperature

$t_{DP}(\varepsilon_2)$ =60$^0$C. In tab.1 there are dew point temperatures, evacuated air flow temperatures and specific heat consumption.

Knowing that enthalpy analytical expression is [1]:

h=1.006t+x(2500+1.863t) kJ/kg; results: $h_i$=63.5 kJ/kg; $h_o$=466 kJ/kg; $h_e$=407 kJ/kg; $h_m$=103.62 kJ/kg (1)
$t_m$ =64$^o$C; $\Delta h/\Delta x$=2839 kJ/kg

Identically result all the values from tab.2.

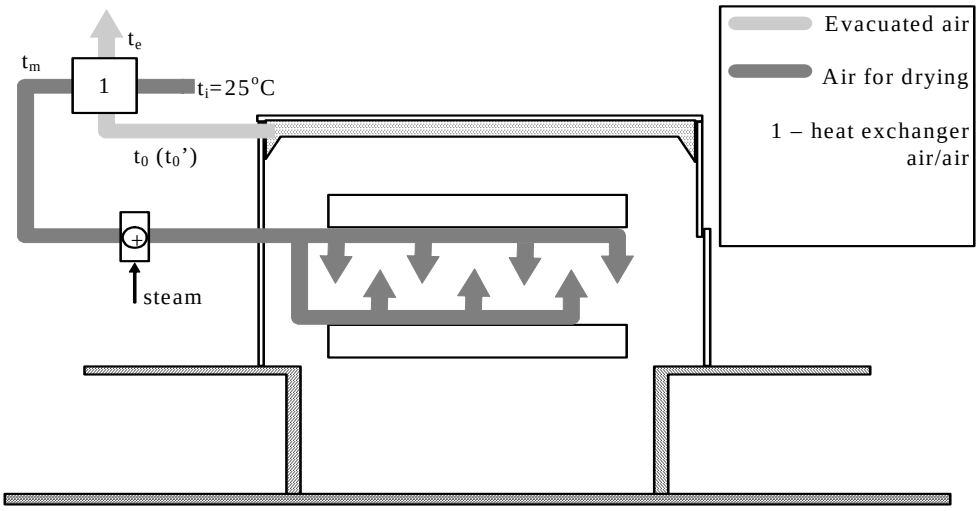


Fig. 1.Drying section with heat recovery in heat exchanger "1"

Calculus was made considering a mixture of 20% false air and 80% evacuated air. Specific consumption is calculated as variation of evacuated air enthalpy with no false air (for example $t_{DP}$=60$^0$C, $t_0$=82$^0$C and $t_0$>$t_0$').

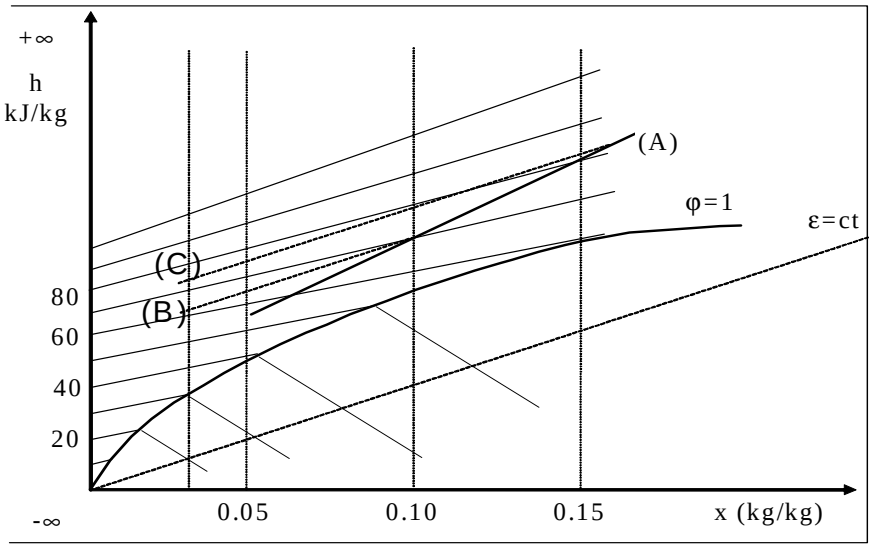


Fig. 2.Processes in Moliere diagram

In tab.2 is noticed that a diminishing of dew point temperature from 60$^0$C to 50$^0$C means a rise of specific consumption with 7,5%. For an identical calculus [2] for dew point temperature of 70$^0$C, specific consumption will decrease.

Table 2. Calculus of specific consumptions

| $t_{DP}$ $^oC$ | $t_0$ $^oC$ | $t_m$ $^oC$ | $(\Delta h/\Delta x)_2$ kJ/kg |
|---|---|---|---|
| 50 | 71 | 45 | 3054 |
| 52 | 73 | 48 | 2998 |
| 54 | 75 | 52 | 2947 |
| 56 | 78 | 56 | 2908 |
| 58 | 80 | 60 | 2871 |
| 60 | 82 | 64 | 2839 |

So, $t_{DP}=60^0C$ is an optimum value in a large variety of working conditions.

In fig.3 is noticed that for the same value of false air temperature when evacuated air temperature is rising, mixture line slope is diminishing ($\varepsilon_2<\varepsilon_1$). When the slope is diminishing rise the probability that the dew point to be in saturated zone.

So, when the specific consumption diminishes raise the probability of mixture air saturation

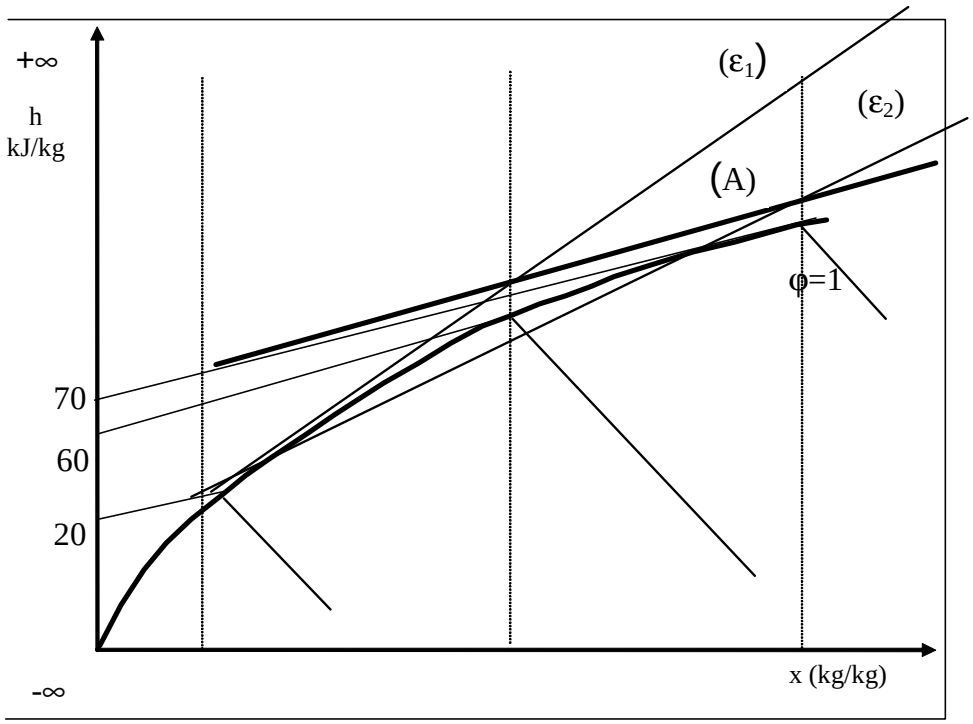


Fig. 3.Mixture line slope variation with evacuated air temperature

We considered fig.4 when false air temperature modifies and evacuated air temperature remains the same.

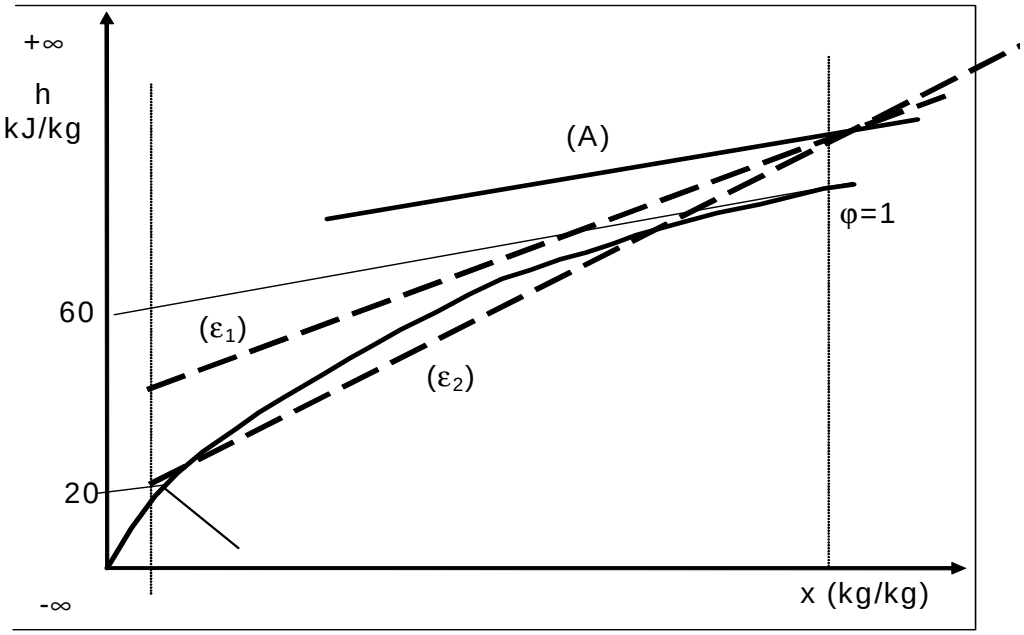


Fig. 4. Mixture line slope variation with false air temperature.

It noticed (fig.3) that when the environment temperature decreases mixture line slope ($\varepsilon_2$) raises and in this way raises the probability of air saturation. The false air humidity was considered $x_i$=0,015 kg/kg, that is the proper value for our environment conditions [2].

## 2. CONCLUSIONS

Taking into account all these aspects of working conditions it can take a conclusion that dew point temperature value could be $t_{DP}=60^oC$. For this value we'll have the best quality paper web and low heat energy consumption for paper drying in a given conditions for false air. A correct ventilation of drying section will improve the drying process and the paper quality, too.

## REFERENCES

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