EINSTEIN Advanced Training Course

Modul AT-02: Verzwickte Fälle
Teil c: Trocknungsprozesse

Unterlagen für KursteilnehmerInnen

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Last update: 07.12.2011

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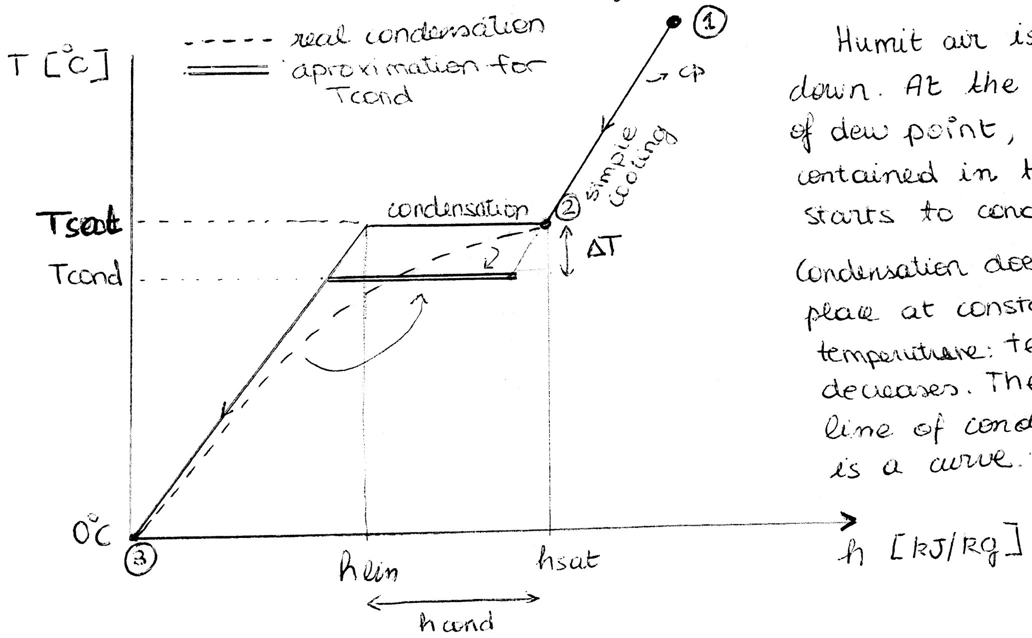
AT02 TRICKY THINGS

C: DRYERS

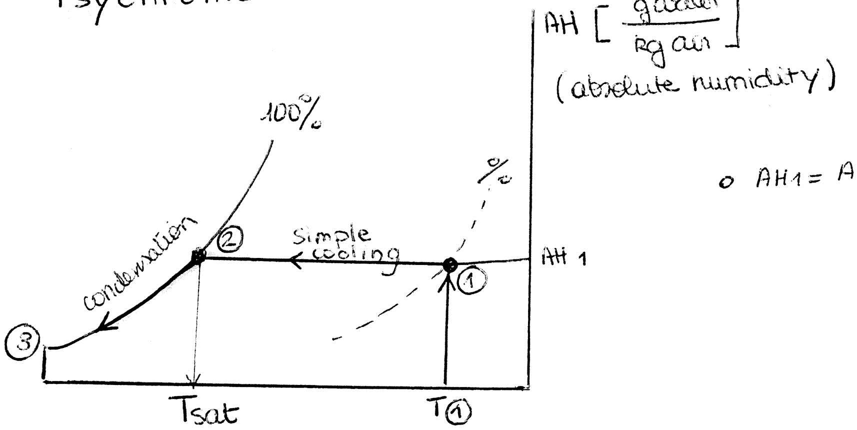
Chapter 4: Representation of humit air in EINSTEIN:



Humit air is cooled down. At the temperature of dew point, vapour contained in the air starts to condensate.

Condensation does not take place at constant temperature: temperature decreases. The real line of condensation is a curve -----

Psychrometric Chart:



o $AH_1 = AH_2$ (simple cooling)

Aproximation

In order to fix a Tcondensation, it will be assumed that it is ΔT °C lower than Tsaturation.

Exercice

① Humid Air

$T = 47°C$

$AH = 27{,}02$ g ~~air~~ water/kg air

$RH = 37{,}1\%$

$h = 115{,}245$ kJ/kg

$DP = 29{,}9°C$ → Saturation

$WB = 33{,}0°C$

AH: absolute humidity

RH: relative humidity

h: enthalpy

DP: dew point

WB: wet bulb

② Dew Point (Start of condensation)

$T = 29{,}9°C$

$RH = 100\%$

$AH = 27{,}02$ g water/kg air

$h = 98{,}120$ kJ/kg

$DP = 29{,}9°C$

$WB = 29{,}9°C$

③ Final temperature

$T = 0°C$

$RH = 100\%$

$AH = 3{,}76$ g/kg

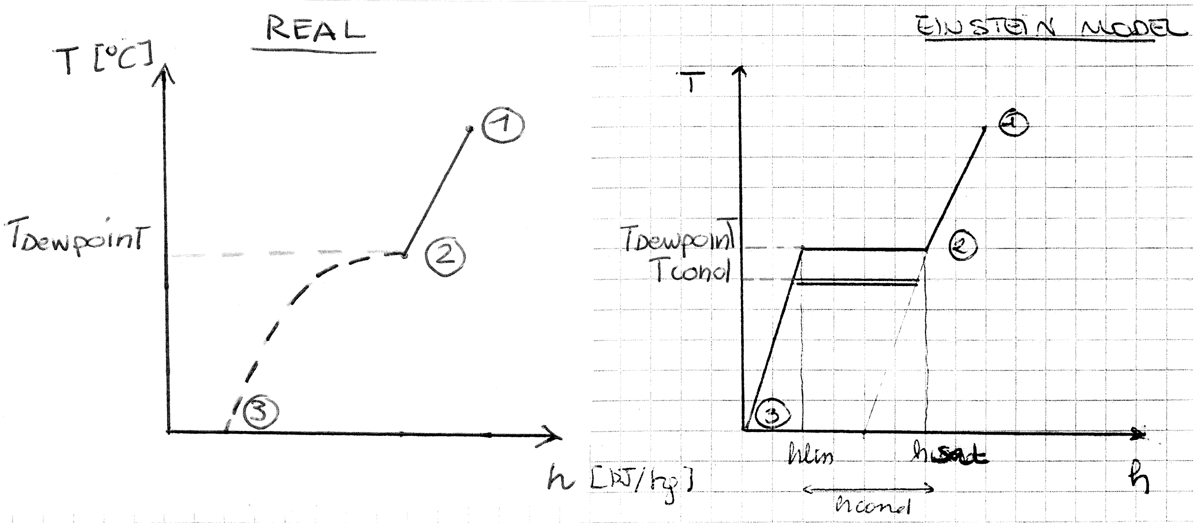
$h = 9{,}493$ kJ/kg

$DP = 0°C$

$WB = 0°C$

Assumptions

$cpl \simeq cpair = 1$ kJ/kg



At $T = 0\,°C$, the fluid has an enthalpy $h > 0$ kJ/kg. However, in EINSTEIN it has to be modelled as if at $T = 0°C \rightarrow$

$h = 0$ kJ/kg

REAL

$h_1 = 115{,}245$ kJ/kg

$h_2 = h_{sat} = 98{,}120$ kJ/kg

$h_3 = 9{,}493$ kJ/kg

EINSTEIN MODEL

$h_1' = h_1 - h_3 = 115{,}245 - 9{,}493 = 105{,}75$ kJ/kg

$h_2' = h_2 - h_3 = 98{,}120 - 9{,}493 = 88{,}63$ kJ/kg

$h_3' = 0$

$h_{lin} = cp_{air}\ T_{sat} = 1 \times 29{,}9 = 29{,}9$ kJ/kg

$h_{cond} = h_{sat} - h_{lin} = 88{,}63 - 29{,}9 = 58{,}73$ kJ/kg

$\Delta T = T_{dewpoint} - T_{cond}$

We choose $\Delta T = 5$ K

$T_{cond} = 29{,}9 - 5 = 24{,}9$ °C