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Selko®

Pelleting Process
The importance of Steam Conditioning

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trouw nutrition
a Nutreco company

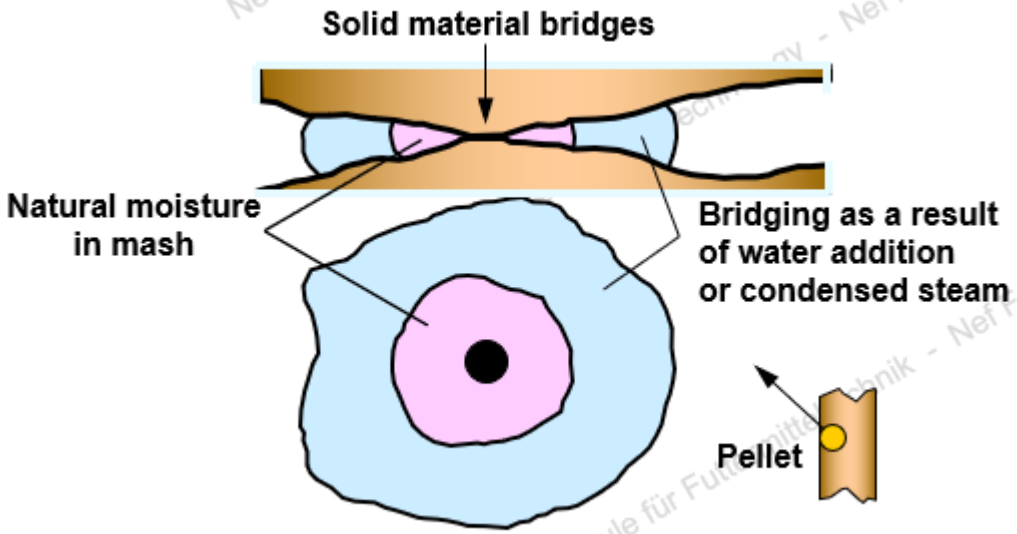
Hygienizing & Compacting – Influencing factors & aimed target.

- **Raw material / mash (55 – 65%)**
  - *Physical characteristics*
  - *Chemical characteristics*
  - *Preparation of mash*
  - *Pelleting aids*
- ***Process control (15 – 20%)***
  - *Steam conditioning*
  - *Throughput regulation*
  - *Moisture control*
  - *Fine returns*
- **Machine / Pellet mill (15 – 20%)**
  - *Die circumferential speed*
  - *Die configuration*
  - *Roll configuration*
  - *Roll gap adjustment*

→ ***Behaviour in pelleting*** →

Pellet quality
Stability / Durability
Energy consumption

Steam conditioning – Introducing heat & moisture.



Objective of steam conditioning.

- *Plasticizing of solid particles.*
- *Creation of liquid bridges.*
- *Improvement in moisture balance.*
- *Partial starch modification.*
- *Longer service life of dies and rolls.*
- *Reduction of pathogenic germs.*
- *Reduction of production cost.*
- *Generally, applies …*
  The higher the conditioning temperature the better the quality, the lower the specific energy.
- *Limited at around 80 – 85°C.*
  Max. moisture content, Destruction of nutrients.
- *Increase in product temperature by 10°C, results in an increase of product moisture by 0.6 – 0.7% H_2O.*
- *Utilizing slightly superheated steam.*
  5 – 10°C above saturated steam temperature.

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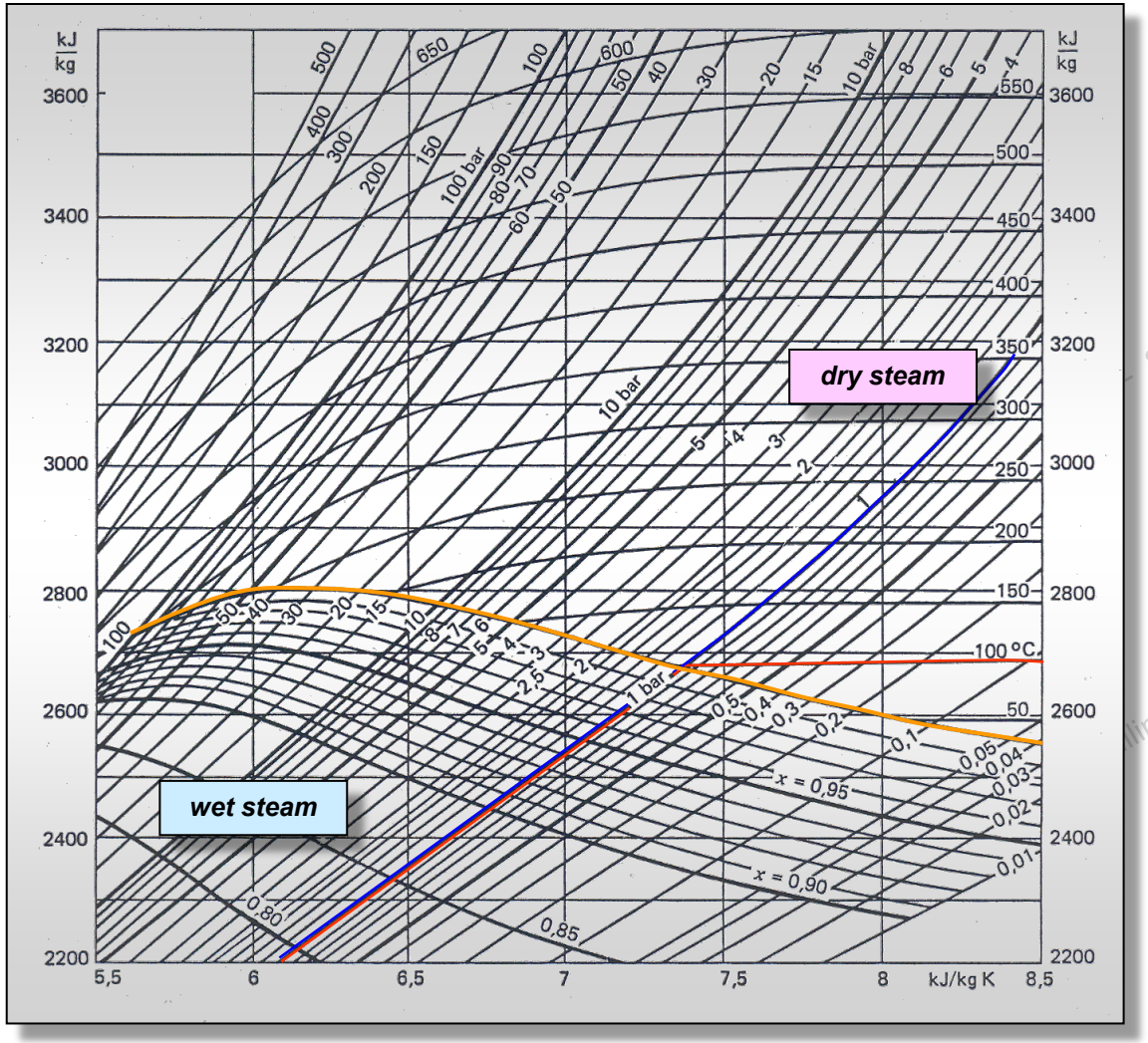
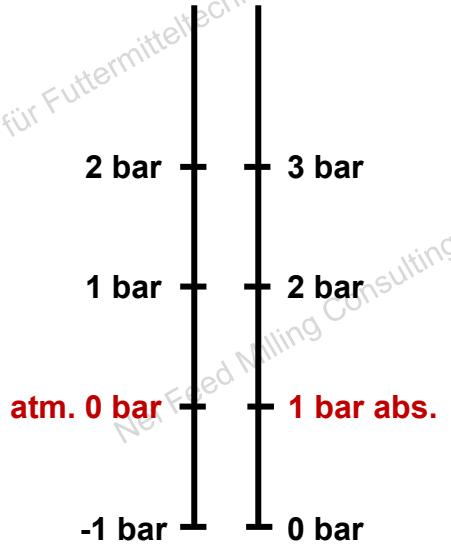
i,s – diagram for steam (acc. to Mollier) – Requirements to steam quality.



Note:

Pressure indications in steam diagrams are mostly in absolute pressures.

Pressures.



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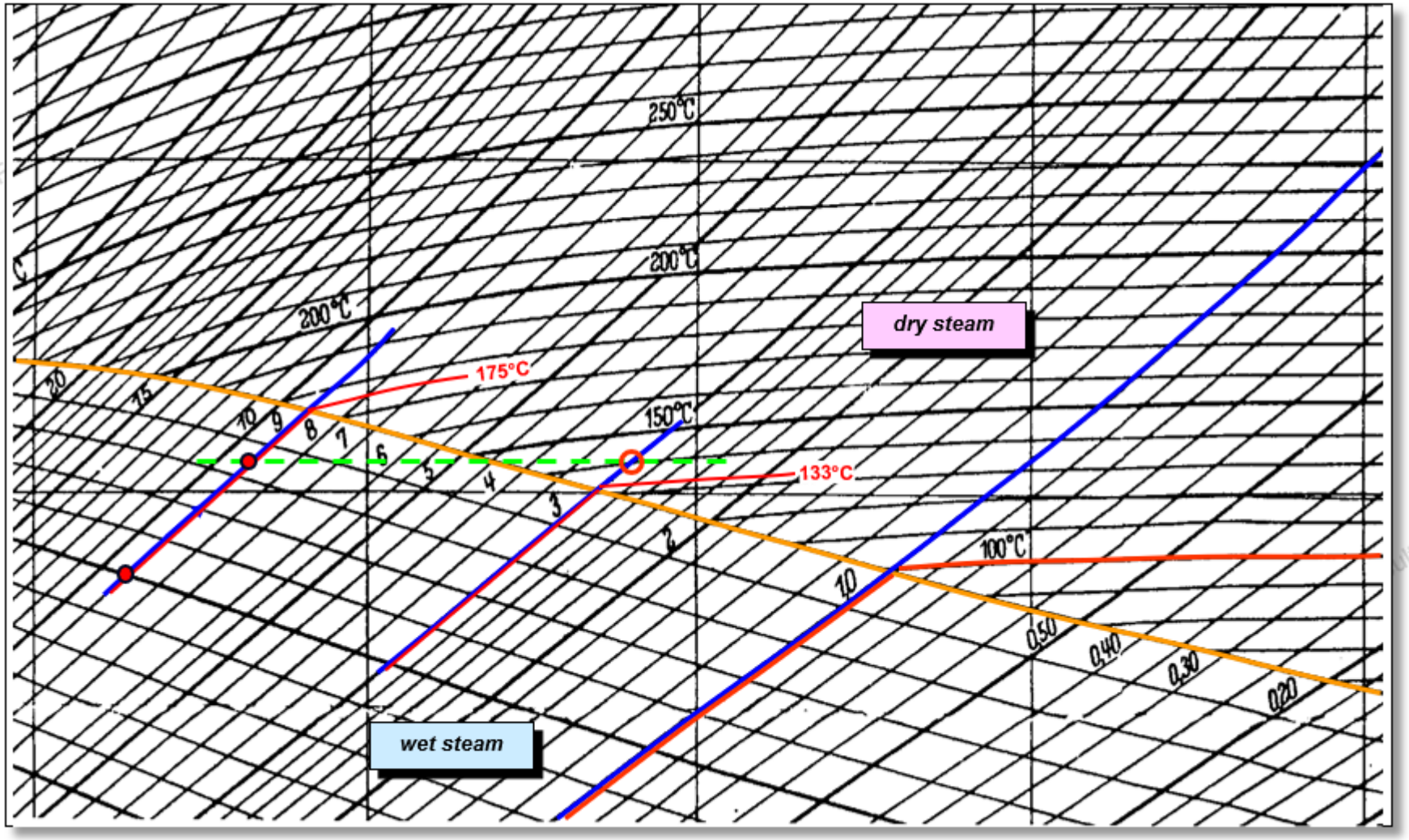
i,s – diagram for steam (cut-out) – Requirements to steam quality.



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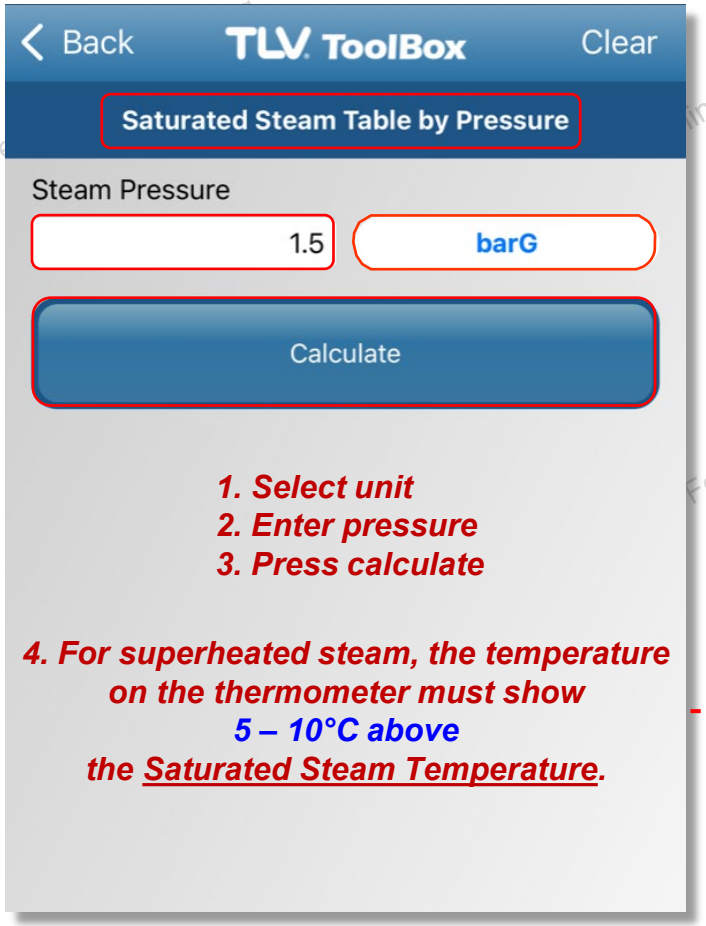
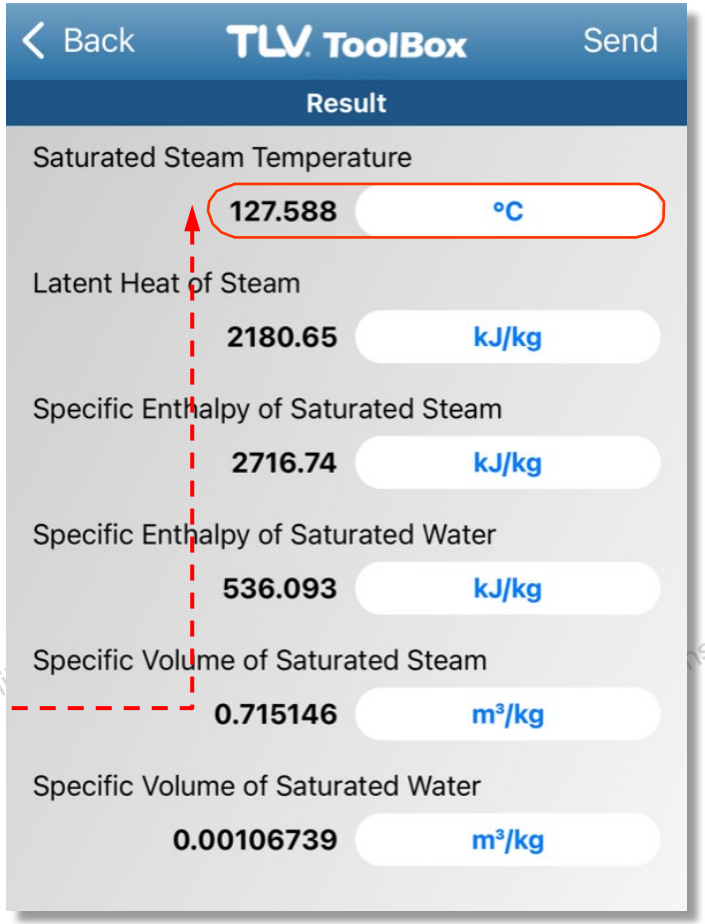
App Store for iOS & Android >>> TLV ToolBox >>> select "Steam Tables".





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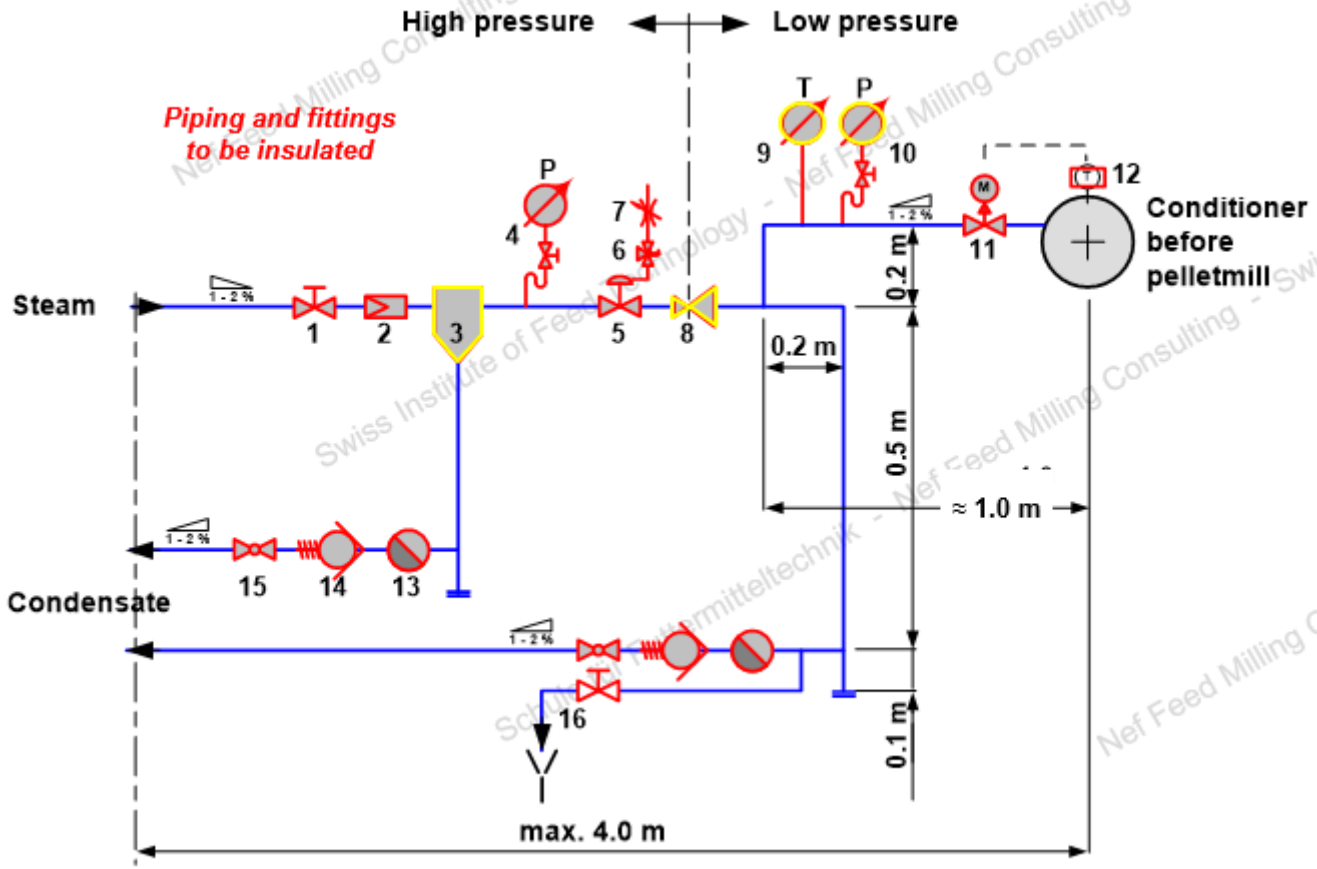
Steam installation for pellet mill conditioner (direct addition).



1 Shut-off valve
2 Strainer
3 Water separator
4 Pressure gauge 4..16 bar
5 Fast-action shut-off valve
6 Solenoid valve
7 Throttling check valve
8 Pressure reducing valve (PRV)
9 Temperature gage 0..200°C
10 Pressure gauge 0..10 bar
11 Modulating valve
12 Temperature sensor
13 Condensate trap
14 Non return valve
15 Ball valve
16 Fast-action water drain

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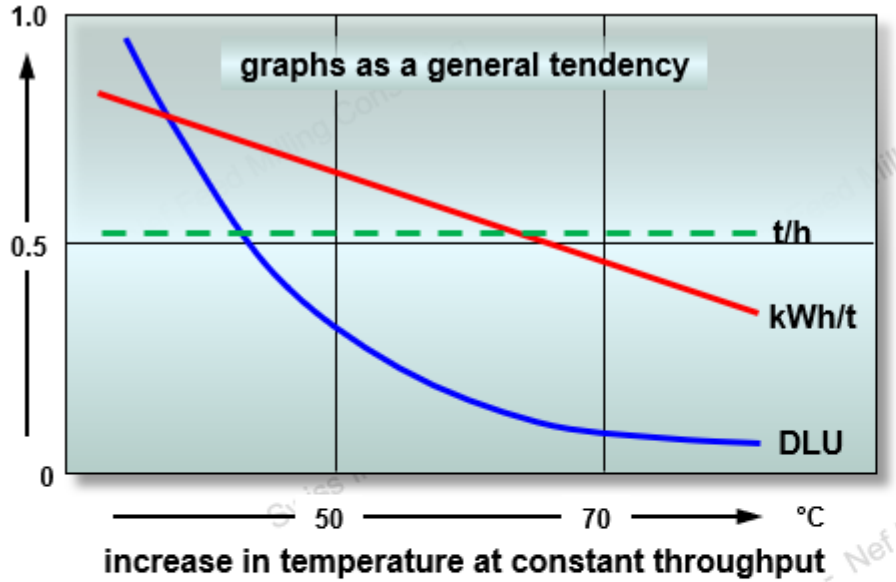
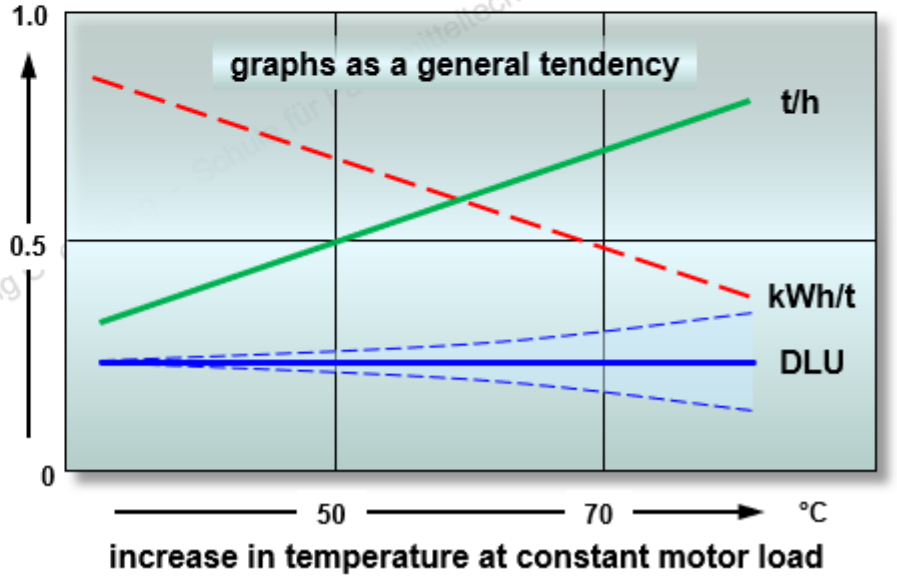
Conditioning temperature – Effect on quality, energy and throughput.

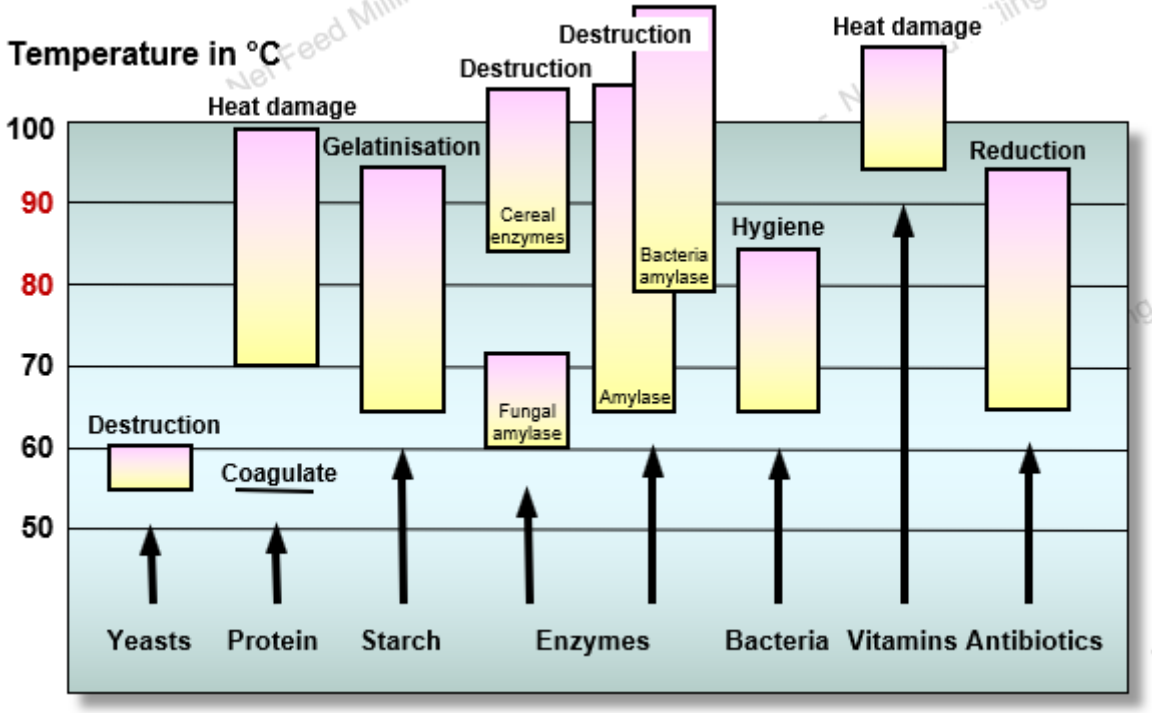


At temperatures above 80 – 85°C the improvement in pellet quality starts to stagnate.

Depending on mash properties, steam conditioning may not be able to compensate throughput increase in terms of pellet quality.

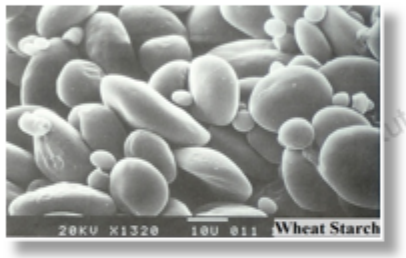


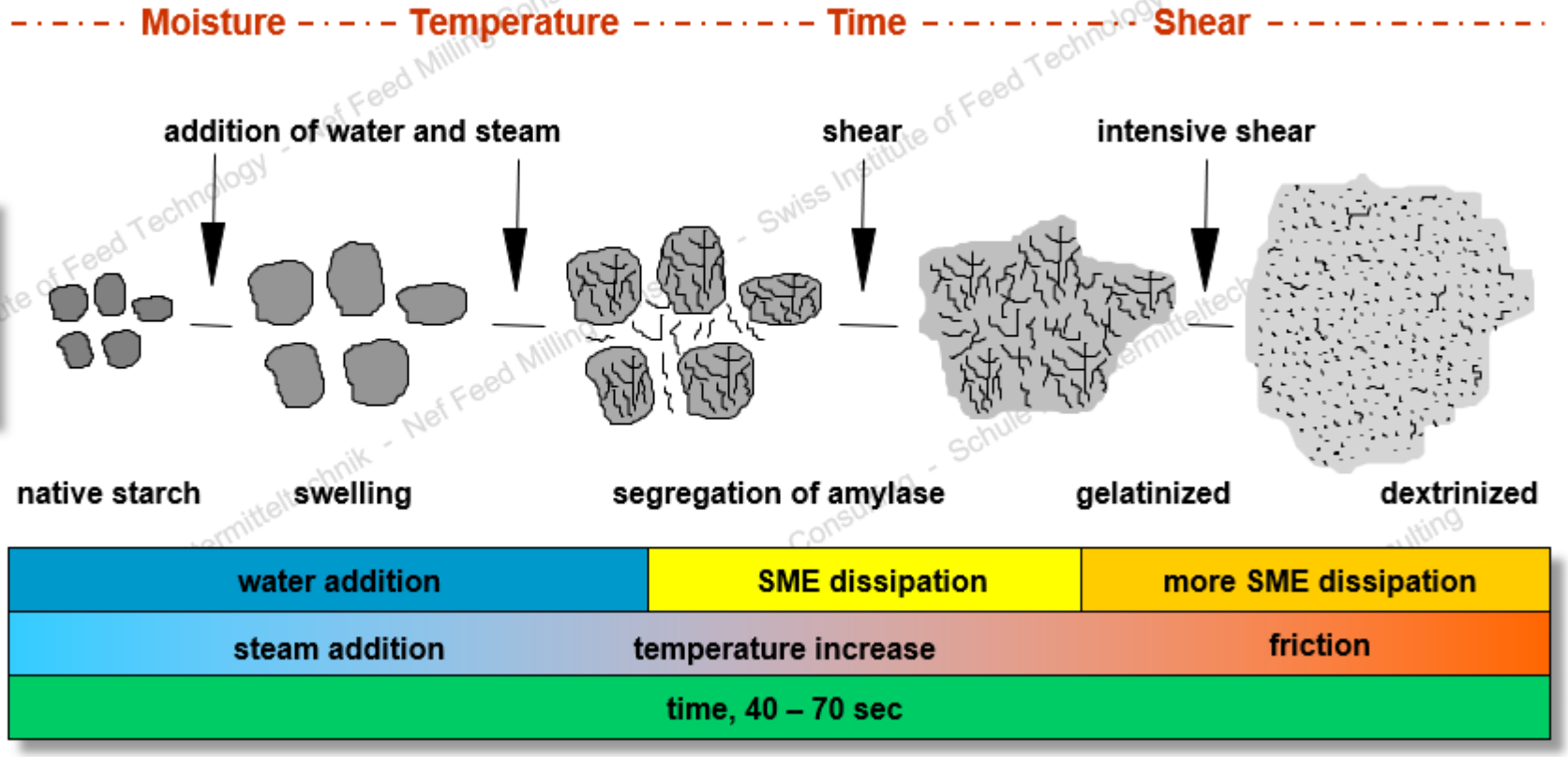
Conditioning temperature and its effect on nutrients & micro-organism.



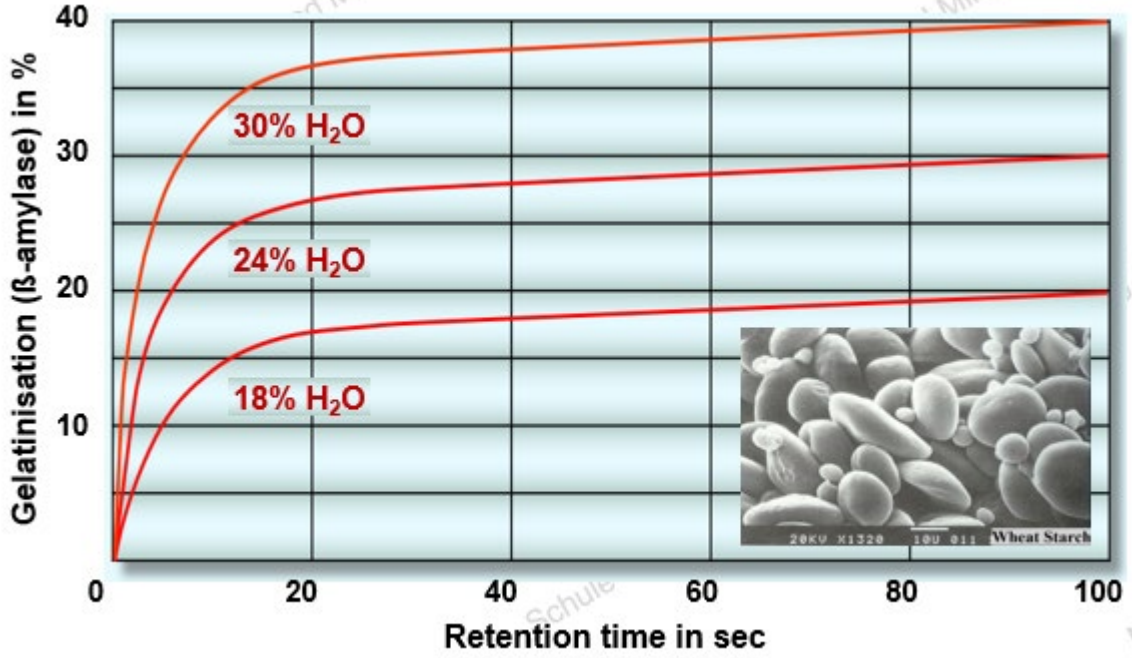
- **Limiting factors for conditioning temperature.**
  - ***Moisture content before pelleting.***
    - ***Choke of pellet mill at 15 – 18 % H_2O.***
    - ***Moisture reduction by cooling.***
  - ***Influence on nutrients & active substances.***
    - ***Destruction & heat damages.***
    - ***Loss in quality / Maillard-effect.***

Course & requirements of starch modification in the extrusion process.



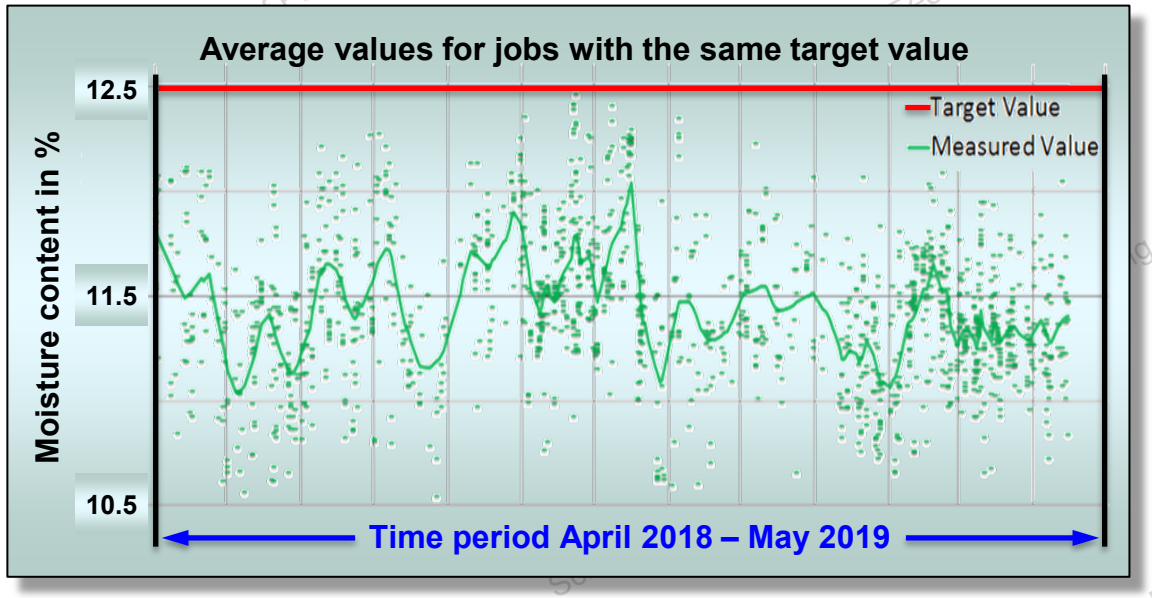


Conditioning & pelleting – Influence H_2O content on starch gelatinization.



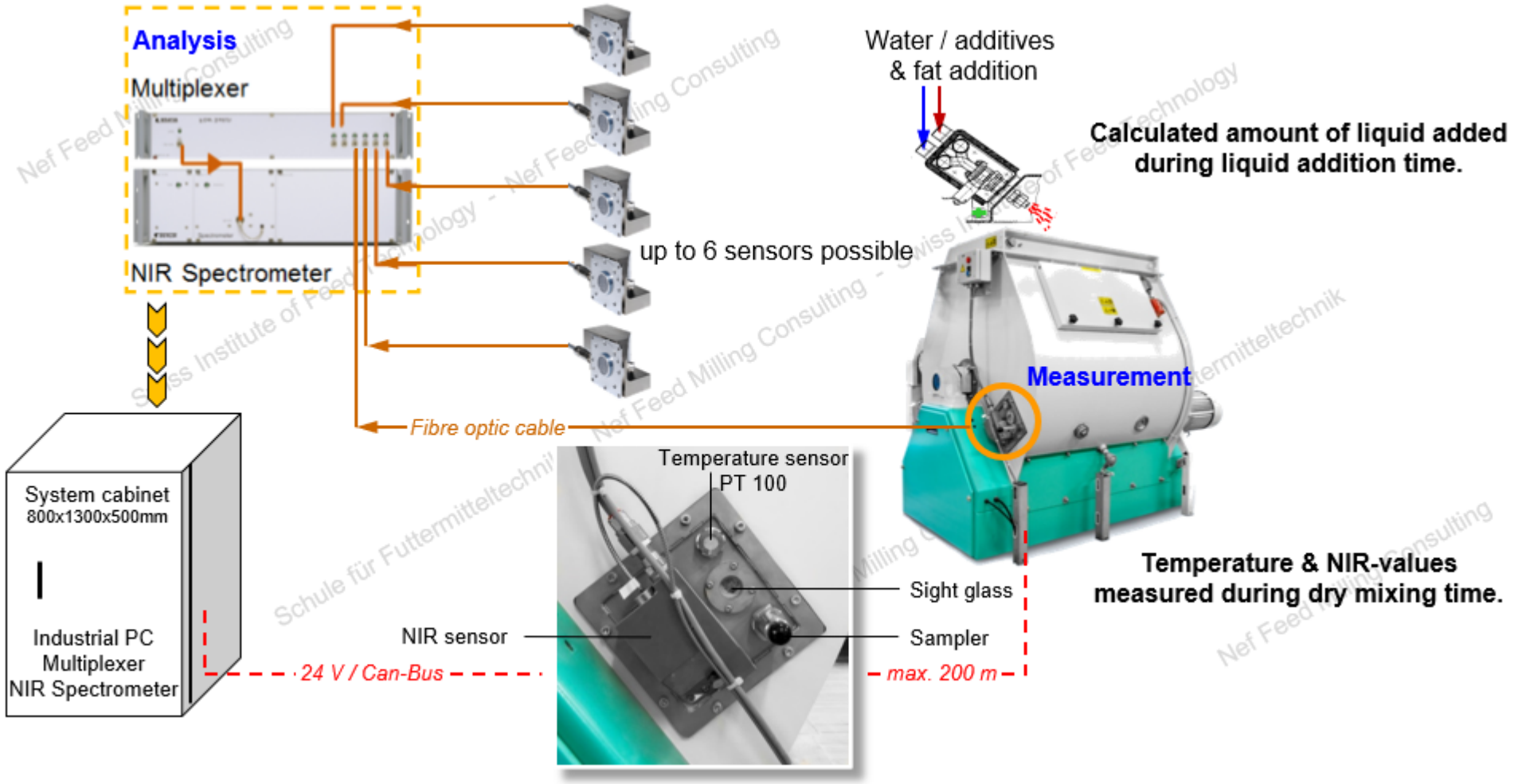
- **Gelatinisation degree of wheat starch at conditioning temperature of 90°C**
  - ***Transfer of native grains into swelling grains.***
    - ***Needs a temperature above 80°C.***
    - ***Needs a moisture content above 20% H_2O.***
    - ***Retention time not as important.***
  - ***Unfortunately, not available in pelleting process.***
    - ***Gelatinisation degree low as 10 – 20%.***
    - ***Applied analysis method to be mentioned.***

Moisture variations in feed rations within one year (measured in Europe).



- **Fluctuations in nutrients and quality due to …**
  - *… origin, type and state of raw material.*
  - *… losses during storage conditions.*
  - *… losses in feed production processes.*
  - *… season and climatic influences.*
- **Constant moisture content at the pelleting process provides …**
  - *… lower energy consumption.*
  - *… good and constant pellet quality.*
  - *… higher availability of pellet mill.*
  - *… less product spoilage / mould formation.*

Online moisture & nutrient control at the batch-mixer (NIR).



Online moisture control for constant H_2O content at the pelleting process.

Our example:

Temperature mash mixer	30°C	set cond. temperature	80°C
Moisture mash mixer	11%	desired moisture	16%

Calculation:

Δt °C (80°C – 30°C) = 50°C x 0.65 % H_2O *(average of 0.6 – 0.7%)*

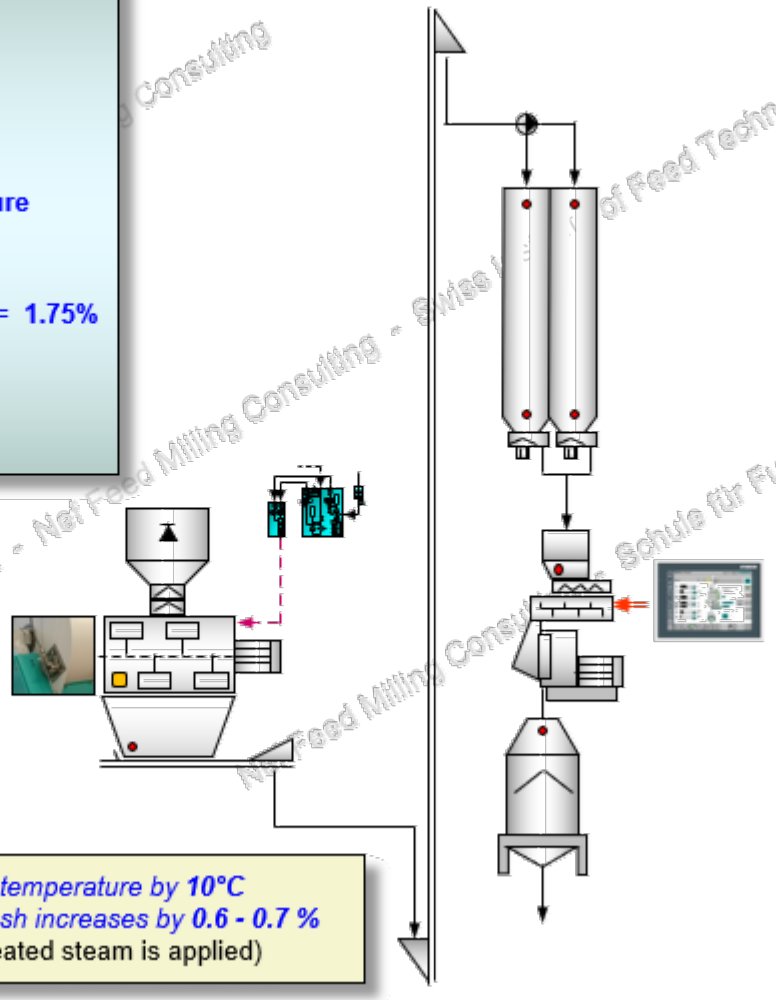
$\frac{\text{50°C x 0.65 \% H}_2\text{O}}{\text{10°C}}$ = **3.25 % increase in moisture**

Moisture mash pellet mill (11% + 3.25%) = **14.25%** Δ% H_2O to 16% = **1.75%**

Solution: **Plant control asks for the addition of 1.75% of water into the mixer or into the conditioner.**

Inline NIR-system measures moisture and temperature of mash during dry mixing time.

Example: temperature 30°C
moisture H_2O 11%



The set value of conditioning temperature on the pellet mill control must be known.

Example: set cond. temperature 80°C

Additionally, the desired moisture content of the mash in front of pellet mill must be defined.

Example: desired H_2O content 16%

From physics we know *by increasing the conditioning temperature by **10°C***
*the moisture content in the mash increases by **0.6 - 0.7 %***
(providing that slightly superheated steam is applied)

NIR or Microwave sensors.

Addition of water & possibly additives. (mould inhibitor / surfactant ...??)

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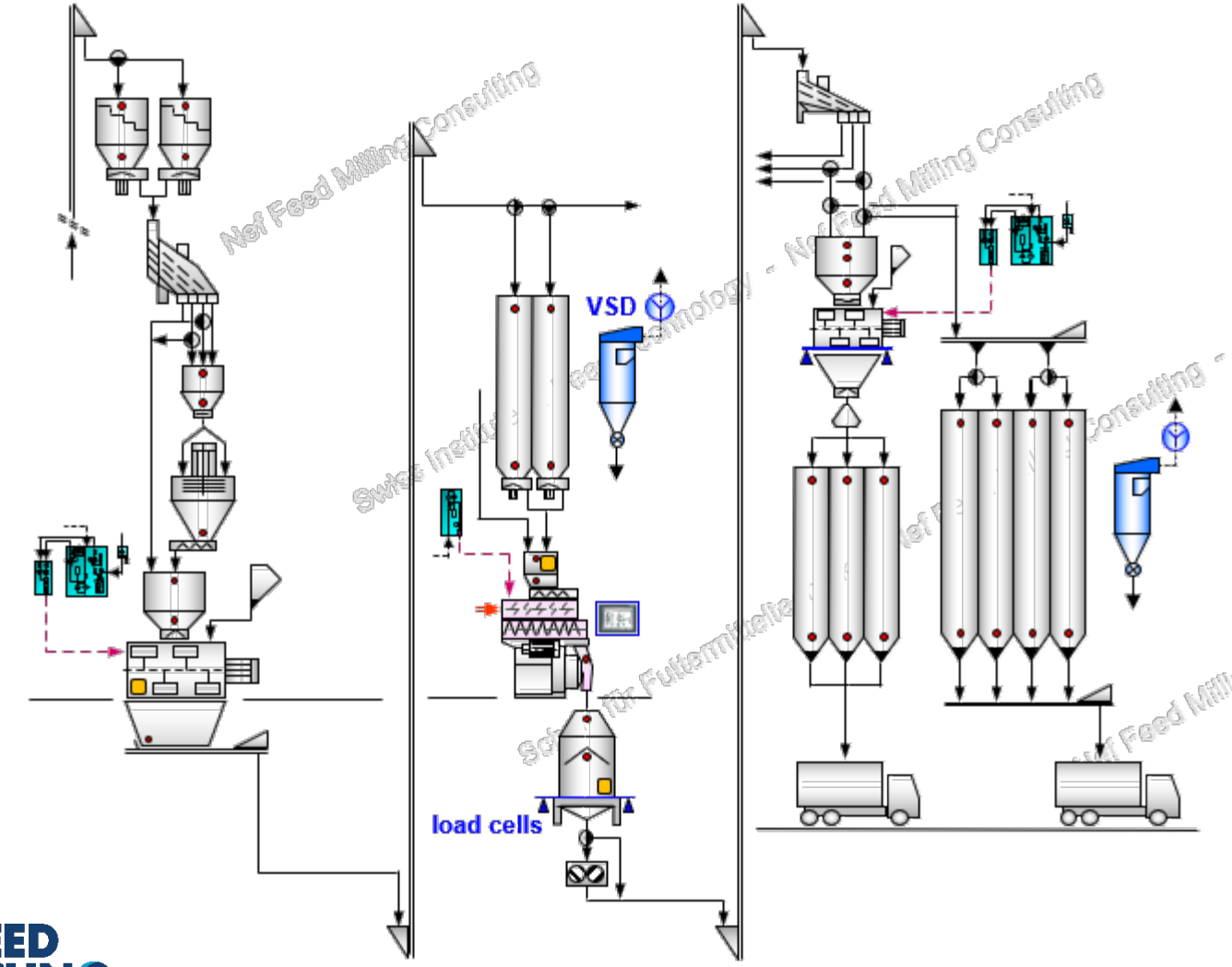
Total moisture control & addition of heat sensitive additives by PPA .



- **Cooling of pelleted feed.**
  - *Depend on moisture content & size of pellets, time of the day/year, season & climate.*
    - Adjustment of retention time required.
    - Adjustment of air volume required.
  - *Cooler on load cells or radar level sensor.*
  - *Air volume control by VSD at the exhaust fan.*
- **Post Pelleting Application PPA.**
  - *Minimum risk for cross contamination.*
  - *Discontinuous systems for highest accuracy.*
    - Mixer on load cells 40 to 45 batches/hour.
  - *Last possibility to balance moisture content.*

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Message to take home.

- **Steam conditioning and moisture balance are essential for a successful pelleting process.**
  - ***Ensure the use of good steam quality, "slightly superheated steam".***
  - ***High conditioning temperatures are the key for better pellet qualities & lower energy consumption.***
  - ***Conditioning temperatures are limited by the max. moisture content & the effect on nutrients.***
  - ***Starch modification in the pelleting process is limited, due to lack of product moisture.***
  - ***Constant moisture levels contribute to an efficient pelleting process – quality & energy.***

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THAT'S IT – THANK YOU

QUESTIONS ??