

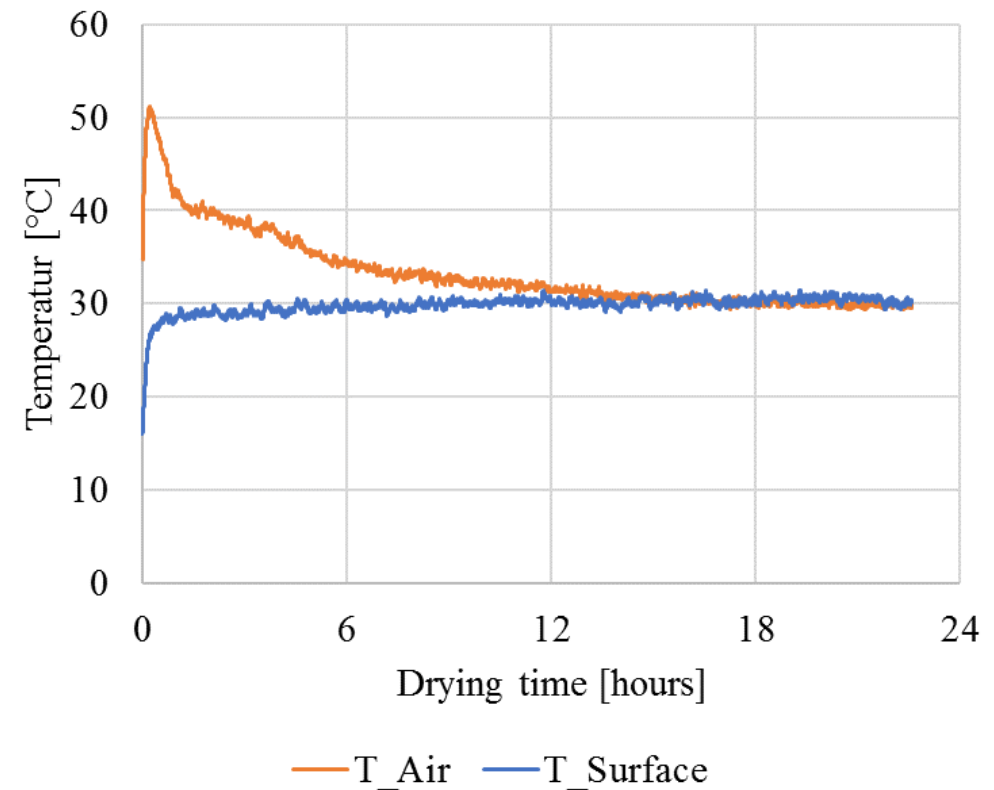
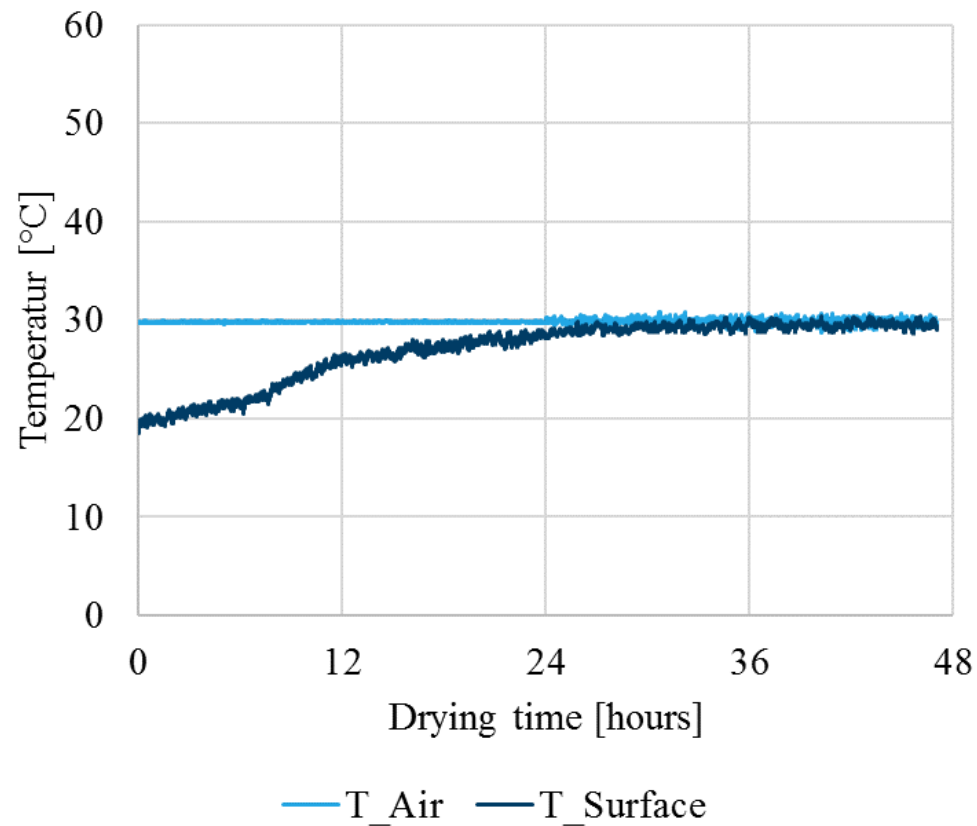


IMPROVED PROCESS CONTROL BY SURFACE TEMPERATURE-CONTROLLED DRYING ON THE EXAMPLE OF SWEET POTATOES

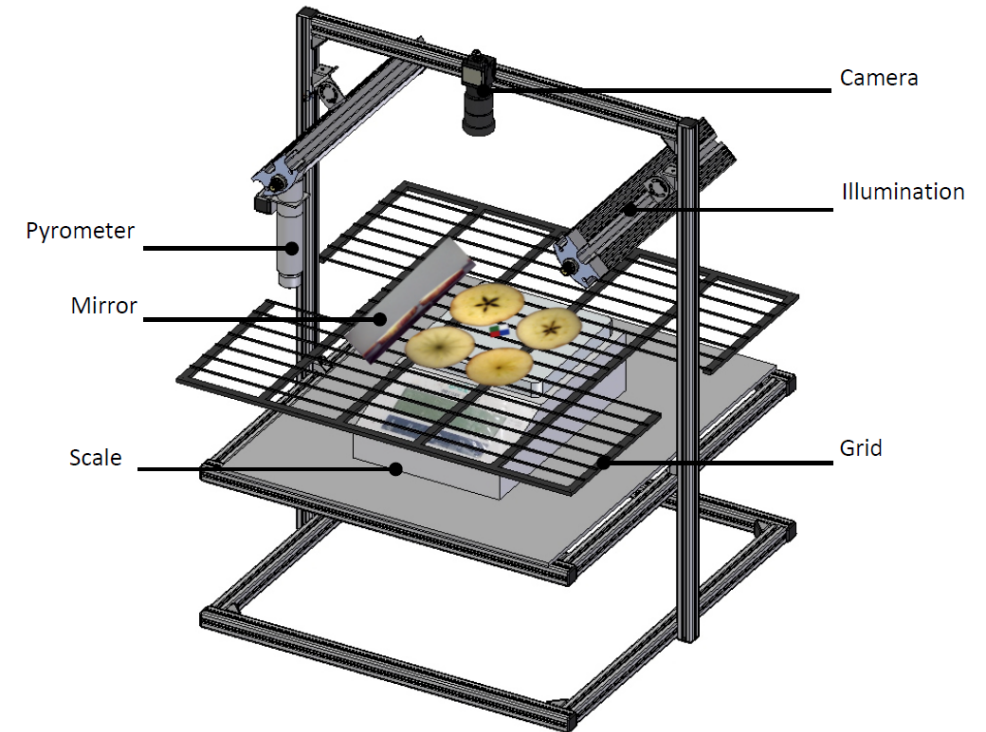
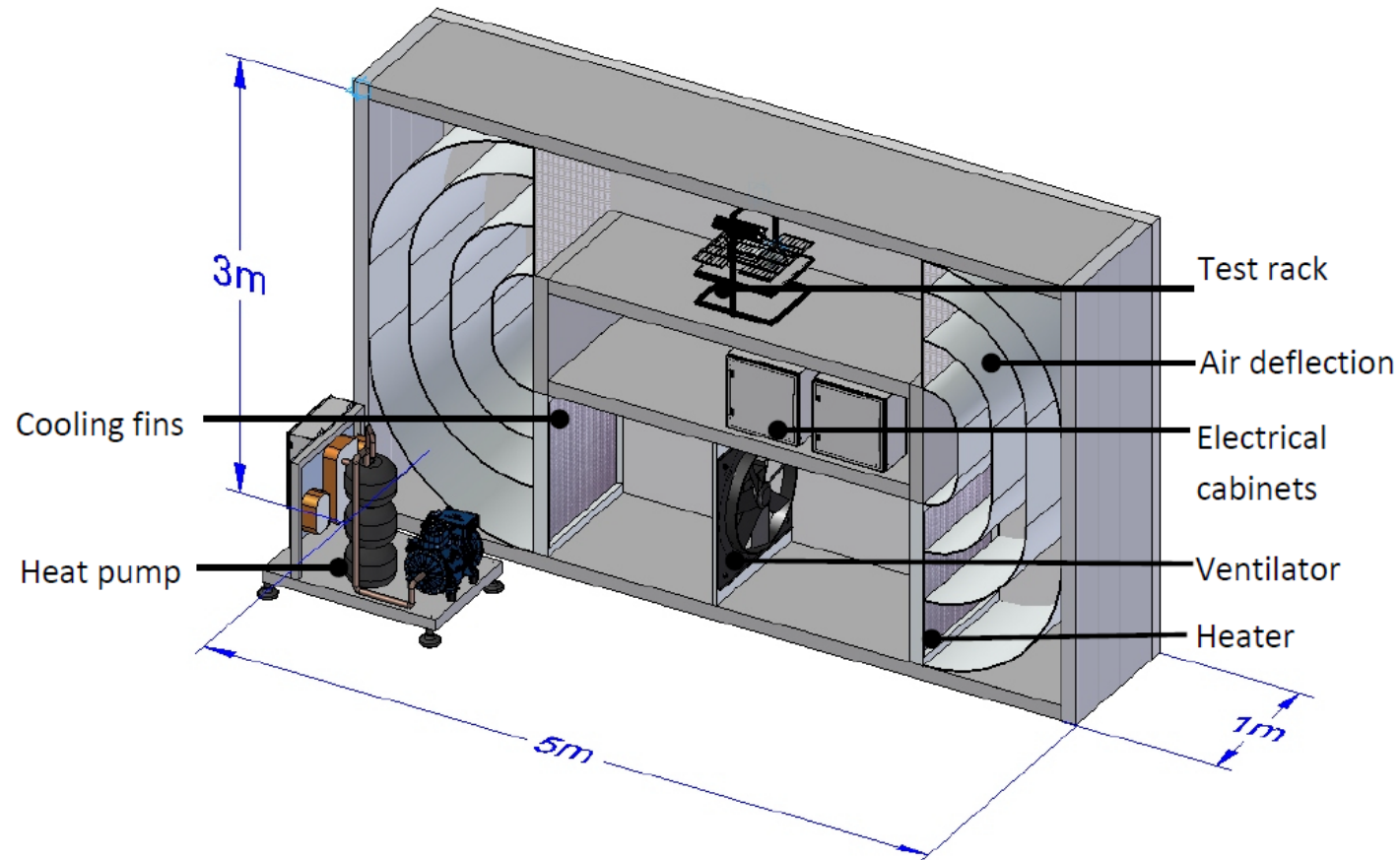
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Eurodrying 2019

Drying at constant temperature (?)



Drying system



Overview of the test series

Test name	Constant temperature	Temperature, T [°C]	Rel. humidity, RH [%]	Air velocity, v [m/s]
T20_Air	Air temp.	19.8 ± 0.2	32.1 ± 2.1	1.0 ± 0.05
T30_Air	Air temp.	29.8 ± 0.2	29.4 ± 1.8	1.1 ± 0.04
T40_Air	Air temp.	39.6 ± 0.1	28.0 ± 2.2	1.1 ± 0.03
T20_Surface	Surface temp.	19.9 ± 0.5	33.1 ± 1.5	1.0 ± 0.07
T30_Surface	Surface temp.	29.8 ± 1.0	28.5 ± 3.1	1.1 ± 0.06
T40_Surface	Surface temp	39.4 ± 1.5	28.9 ± 3.3	1.1 ± 0.05

Determination of Deformation

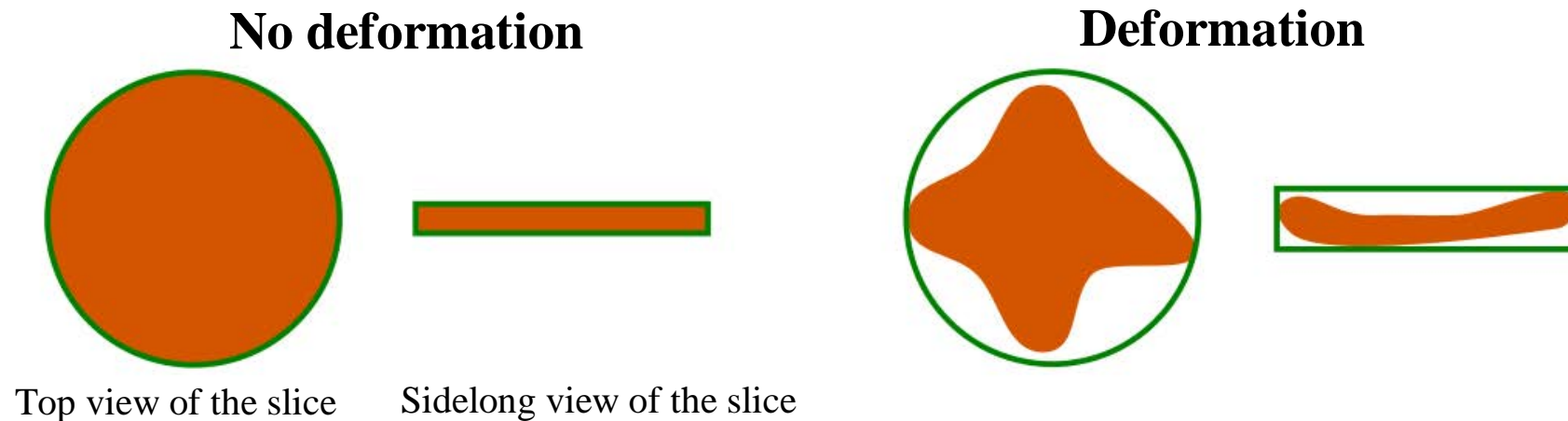


Figure 1: Determination of the deformation.

$$Shrinkage(t) = \frac{Area(t)}{Area_{t0}}$$

$$Deformation(t) = \frac{Area_{slice}(t)}{Area_{enclosure}(t)}$$

Colour Analyse and weight loss

- Browning Index

$$BI = \frac{(x_{D65} - 0.32)}{0.162} * 100$$

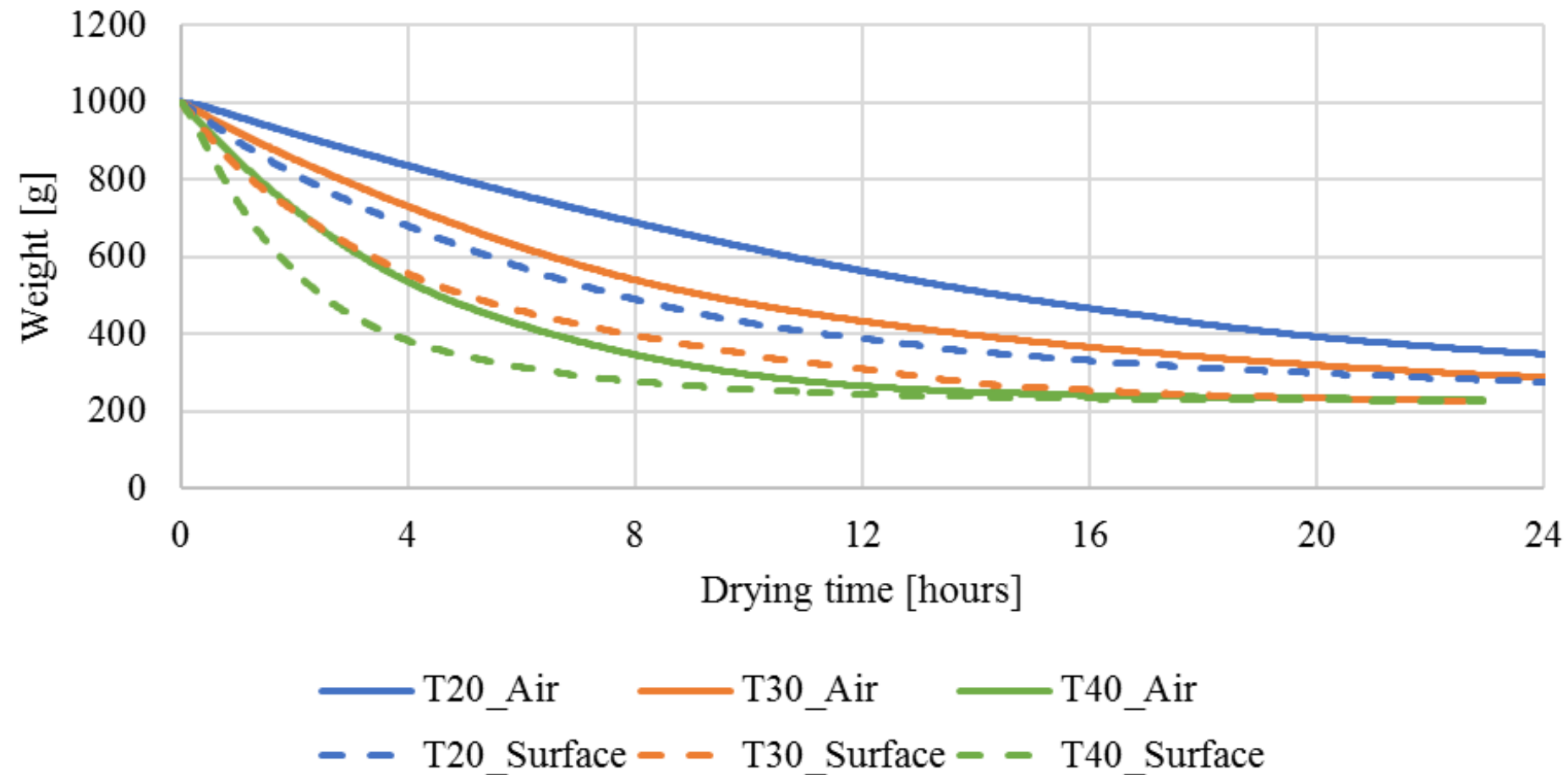
$$x_{D65} = \frac{X}{(X + Y + Z)}$$

- Moisture content

$$X_t = \frac{m_t - m_{dry}}{m_{dry}}$$

$$MR = \frac{X_t - X_{EMC}}{X_0 - X_{EMC}}$$

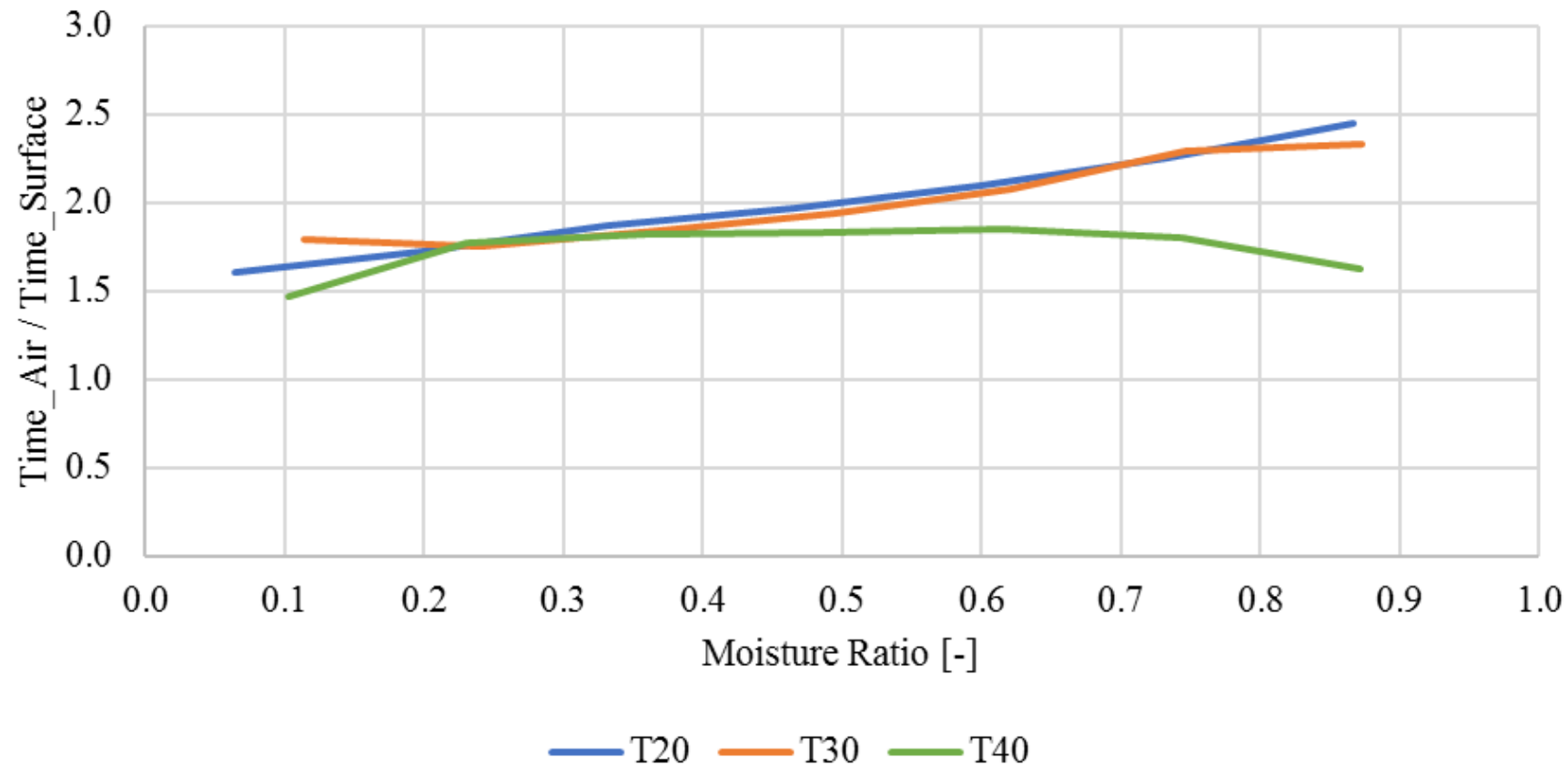
Results Drying Rate



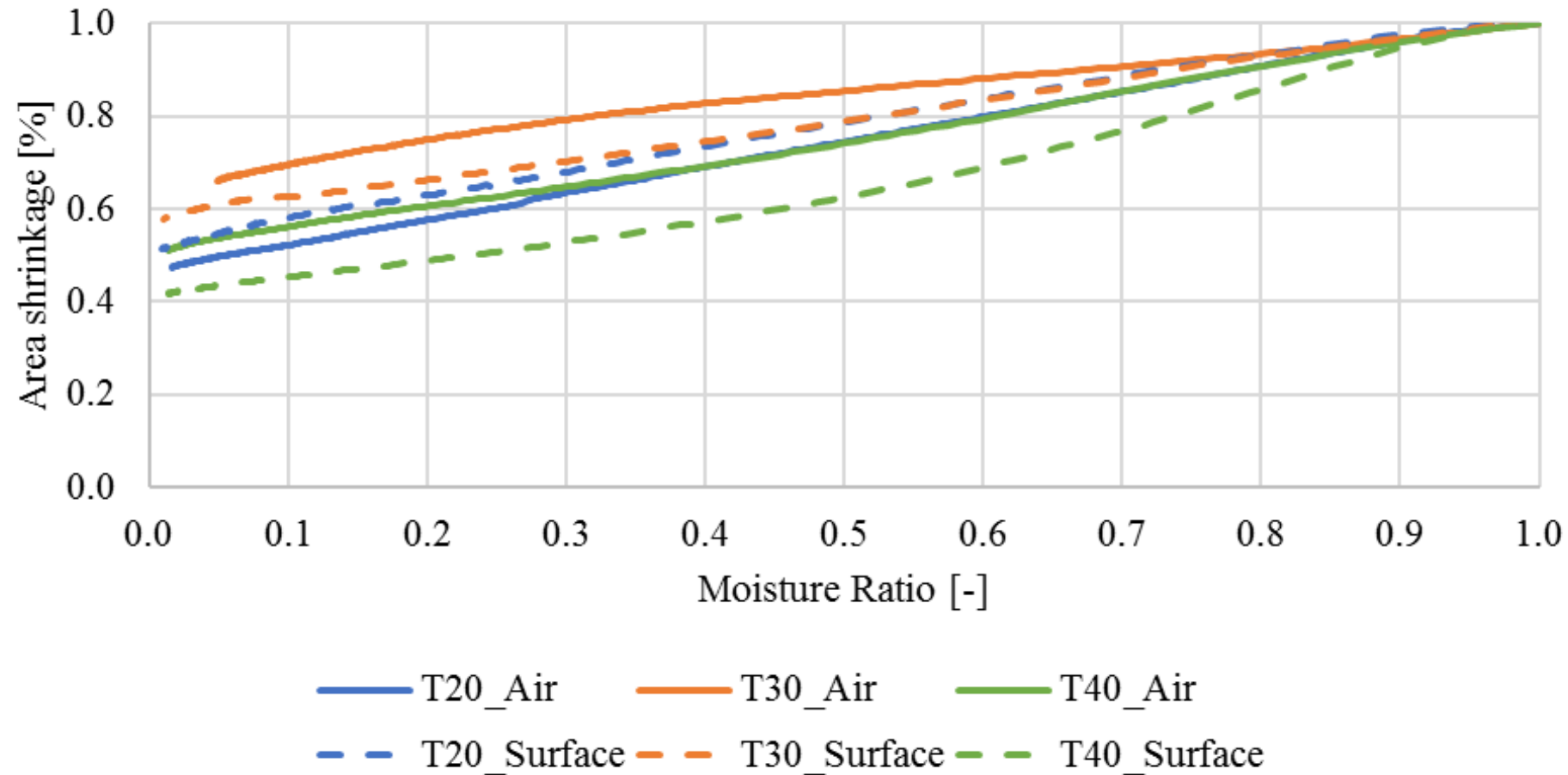
Results Drying Rate (first period)

Temperature [C°]	Air temp. controlled [g/h]	Surface temp. controlled [g/h]	Increase factor of drying rate
T_20	41.5	93.0	2.2
T_30	74.0	141.0	1.9
T_40	138.5	219.5	1.5

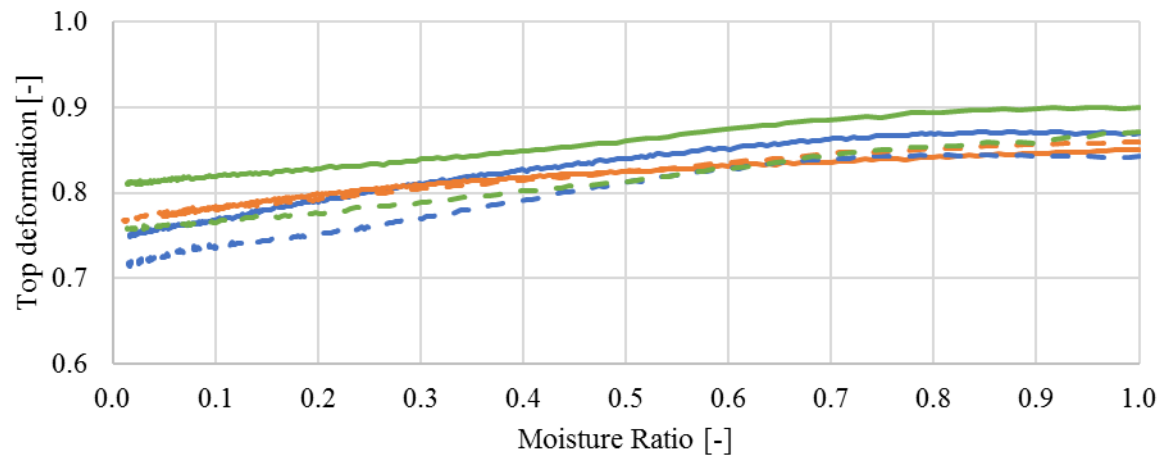
Results Drying Rate (over MR)



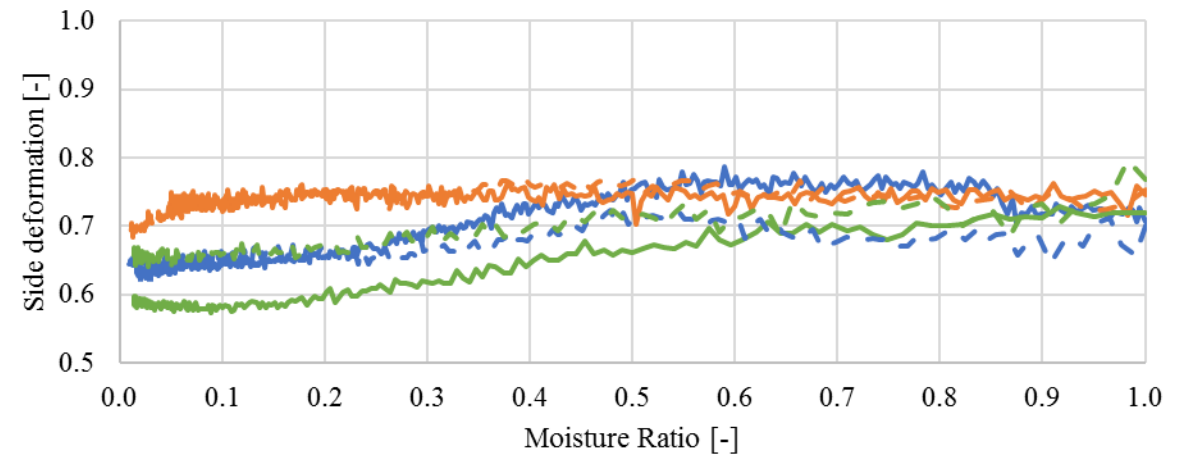
Results Area Deformation (Quality)



Results Side and Top Deformation (Quality)

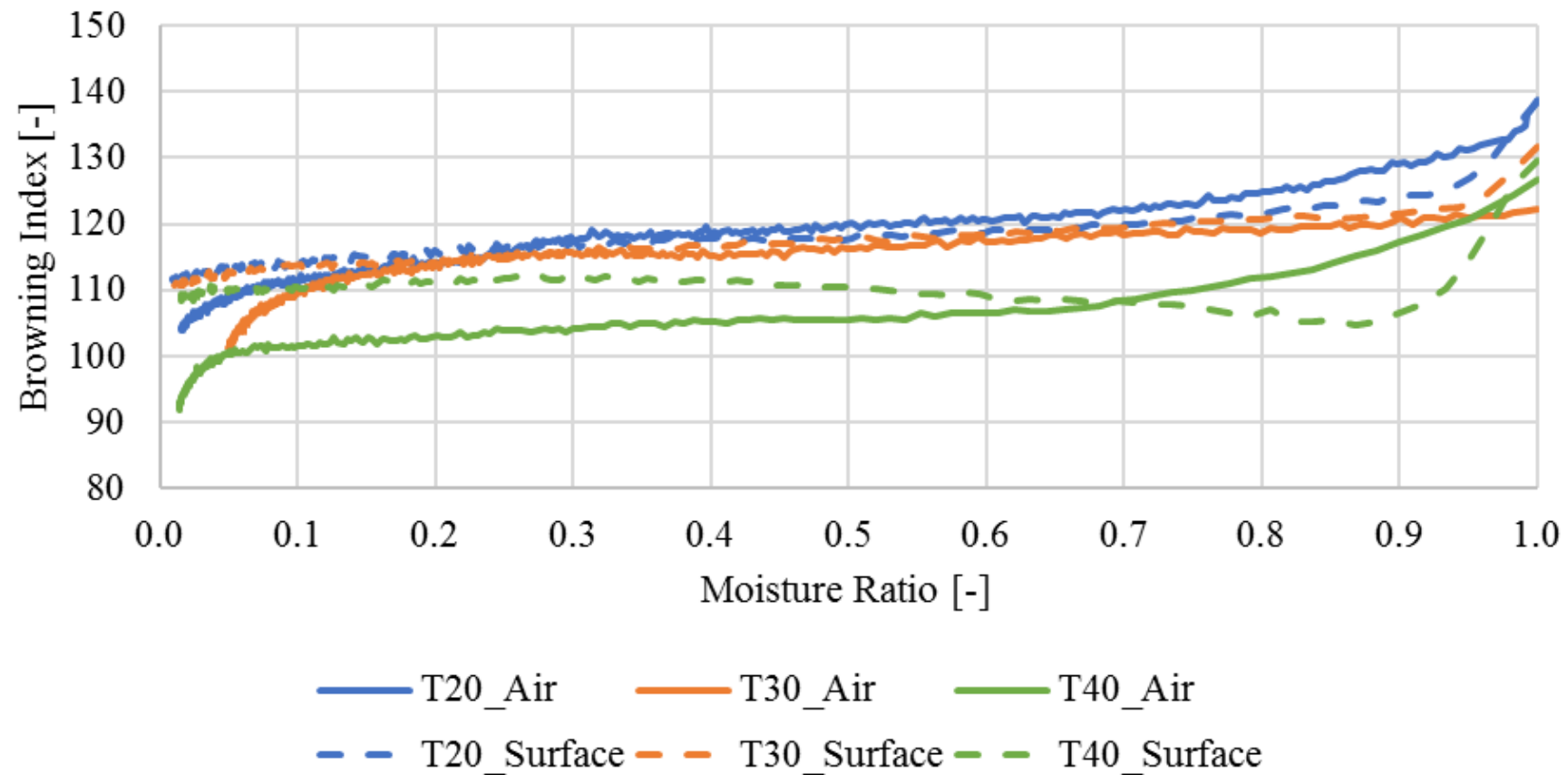


— T20_Air — T30_Air — T40_Air
- - T20_Surface - - T30_Surface - - T40_Surface



— T20_Air — T30_Air — T40_Air
- - T20_Surface - - T30_Surface - - T40_Surface

Results Colour Alternation (Quality)

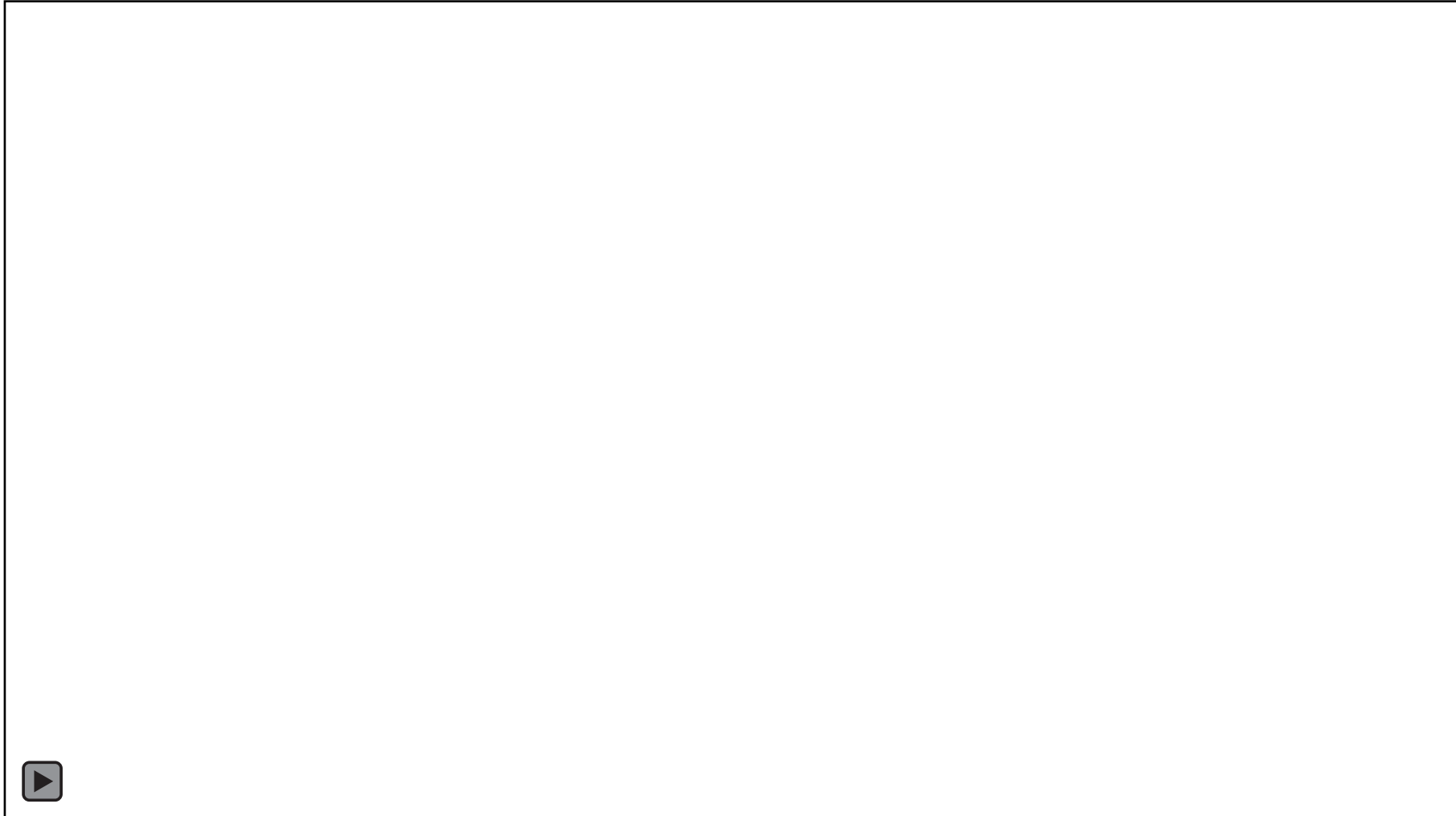


Conclusions

- Surface temperature controlled drying is 1.5 – 2.5 times faster than conventional drying control
 - 5 – 10 % higher area shrinkage with surface temperature controlled drying
 - Deformation: no significant difference
 - Browning Index: no significant difference
- Simple and easy to implement control strategy with high potential to decrease drying time without affect optical "quality" (appearance)**



Video from Drying Experiments



Acknowledgement

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Teknologi for et bedre samfunn