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Pierre Schuck, Anne Dolivet, Serge Mejean, Romain Jeantet. Drying by desorption: a method to determine and optimize the spray drying parameters of food and dairy products regarding to the water availability. 13. International Symposium on the Properties of Water (ISOPOW), Jun 2016, Lausanne, Switzerland. hal-02743528

## HAL Id: hal-02743528 https://hal.inrae.fr/hal-02743528

Submitted on 3 Jun2020

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## Drying by desorption: a method to determine and optimize the spray drying parameters of food and dairy products regarding to the water availability

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The main aim of this study was to develop a method to simulate the transfer conditions (energy and water) of spray-drying. Typical curves were registered with the water activity meter on water, dairy and food concentrates (Fig 1.) [1]. These curves showed that the relative humidity (RH) from the pressure sensor as a function of time can be represented by a sigmoid equation. Two phases can be identified on the curves obtained for pure water and milk concentrates: Initially, at the beginning of desorption, there was a constant RH (ie rate of drying) phase. This constant phase corresponds to free water evaporation. The second phase was the falling rate period, which was very short for pure water and much longer for milk concentrates, whatever the total solid content. We assumed that this corresponded to the evaporation of bound water, which involves extra energy (EE) in order to overcome binding (indirectly the bound strength of water). The area under the curve of each part thus represents the amounts of free and bound water desorbed, respectively. EE is calculated as a function of the drying kinetics according to the desorption curves (Fig 1.). When the drying kinetic of a concentrate is similar to the drying kinetic of pure water, no EE is required. If the drying kinetic is two slower, energy requirement is two higher than for pure water. The difference with the latent heat of evaporation required for pure water determines EE. The calculation method to determine EE was computerized to obtain new software (SD2P®, Spray Drying Parameter Simulation & Determination). From the desorption curve, the software SD2P® (Spray Drying Parameters Simulation & Determination) is a way, among others, to predict the value of these parameters when they are not known [2, 3]. The combined results provide more precise determination of spray-drying parameters (including inlet/outlet air temperature, mass/powder flow rate, powder temperature, etc.), powder state during spray-drying (stickiness) and the cost of spray-drying with respect to weather conditions (Fig 2). Several cases will be presented to show the interest of this strategy in order to anticipate the spray-drying parameters and the powder behavior.

[1] Schuck, P et al. Drying Technology 16 (2008), 1371-1393.

[2] Schuck, P. et al. J. Food Eng. 94 (2009), 199–204.

[3] Zhu, P et al. Dairy Sci Technol. 93 (2013), 347-355.



Fig. 1 – Kinetics of drying by desorption

						×
Field.co Settings	Maccflow rabe (hg14/h)	Enthility (038404)	Sergerature (*0	AH (ahatA)	AH (N)	1
Inlet or before heating		38	20	2	6.6	
Inlet or after heating T	3000		252.9	7	0.00	
Cooky at Ar	500	- 38	20	2	67.8	
Tearshipp in Y	300	38	20		47.8	
Complementary at 12	0	38	20	7	47.8	
Air mix ()+Call +C)	3800	226.1		2	0.07	
Outliet at stage 1(3+C+8=C)	3800		90.5	46.5	10	
25 riet or before heating			20			
TO yiel at alloy bearing T	738	90.9				
P0 solid at Y	738		817		18.3	
Overall suffer, at (3+C+R+C+B)	400	1%	8.2		16.0	
Proposition consults (balls)	-164.1	3.00 CP is take large to a susception due to the				
Meter Resorts in concentrate find	100.2	Dex tempers	37.2			
Concertinate Reservate (hash)	330.5	Groupy baiar	4002			
Conceribrate Revinda ((h))	297.1	Drangy come	2.1			
Conceribule detaily ( )	12	14030/C(%) 40.3				
Canceribate-dry matter (%)	58	Cast (Albon )	61.4			
Powder mointure (%)	-	Cast (ghon powdar) Control V 75.1				
Powder Rowmater (high)	ew nater (high) 196.9 (kith cost (\$)				0.86	
Cancente alto Tampes añure (*C)	- 45	Corresponding standard breakpoint (%)			100	
Caronate (2-53/34*C3	35	Default	Ret	Dent	0.6	1

Fig. 2 – Synthesis page