Production mixer in the laboratory

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This work describes a series of tests for validating mixing sequences on a new laboratory mixer. The received values point out that with the assigned laboratory mixer of the company Somakon the quality forecasts for production mixtures on large mixers used in this investigation are possible. Thus the transmission of the development formulation to the production standard for the application types “powder mixing” and “loading of powders with fluids” became clearly more economical

Definition of project

Mixing tasks in powder production usually precede series of attempts in the laboratory. With these development series also the physical behavior of the final product should be recognizable, in order to countervail in time against problems, like e.g. disturbances at the filling or the inclination for separation at the storage and / or transport.

The company Symrise optimized the laboratory mixer MP-L in co-operation with the company Somakon that in the test stage (100g-preparation) a significant quality forecast of the mixtures in the production standards is already possible for all mixer types used by Symrise.

For the field powder mixing and / or loading powders with liquids the processing parameters at the laboratory mixer MP-L were determined empirically, so leading the preparation sizes < 1kg to products, which are comparable in the physical characteristics with those manufactured in the production standards of up to 2 t. In other words, it should be examined whether the production mixers can be practically simulated in the laboratory.

For this examination different products were manufactured on all mixers included in the investigation. The products were rheologically examined, the results were compared. For each of the three different production mixers was one characteristic formulation selected.

Test conditions

To avoid fluctuations in raw material all mixtures were manufactured from the same raw material portion. Three themselves strongly in the formulation and in the user requirements differentiating products were chosen. The manufacturing processes used in production was transferred to the mixing sequence, addition steps, mixing times / peripheral speeds etc. in the laboratory standards to the laboratory mixers. These were manufactured on the laboratory mixer Somakon MP-L. The therefore necessary procedure regulation was determined empirically before in series of tests. The variables in the processing parameters are on one hand the number of revolutions and mixing time and on the other hand the working tool configuration of the laboratory mixer.
To thereby simulate the respective production mixer in the product demands while mixing.

figure: laboratory mixer MP-L

To avoid of a possible climatic influence all mixtures of a product series were manufactured parallel to each other on one day at the same time. All products of a product series (laboratory- and production goods) were given through the same sieve system and sieve. It was thus tried to have only the mixer types as variable with these attempts.

Assigned mixer types

Mixer type	volume [l]	MP-L- config to simulation module 1 +…	revolution MP-L 0,5	Mixing time MP-L 0,5
Somakon MP-L	0,5			
Somakon MP-L	2,5			
Nauta-Mischer	3600	screw	700 rpm	60s
ploughshare mixer	3000	mixing cross	1250 rpm	35s
Screw mixer	4000	screw	900 rpm	45s

Comparison of further mixing results:

product B	m_{Batch}	angle of repose	piled weight	jolting chute
	kg	cm/60mm	g/ml	min/200g
Somakon	1	4,4	0,63	4,07
Screw mixer	10	4,4	0,62	4,09
Screw mixer	250	4,2	0,61	4,12
Screw mixer	2500	4,6	0,64	4,15

product C	m_{Batch}	angle of repose	piled weight	jolting chute	Retsch vibration sieve				
	kg	cm/60mm	g/ml	min/200g	100µm	250µm	500µm	800µm	1000µm
Somakon	1	3,4	0,45	4,4	61,3	36,2	1,3	0,6	0,6
Nauta	1200	3,5	0,41	4,4	62,3	35,5	1,1	0,6	0,5

product D	m_{Batch}	angle of repose	piled weight	jolting chute	Retsch vibration sieve				
	kg	cm/60mm	g/ml	min/200g	100µm	250µm	500µm	800µm	1000µm
Somakon	1	5,9	0,44	5,3	57,9	39,6	1,4	0,6	0,5
ploughshare	50	6,1	0,44	5,1	59,9	37,9	1	0,7	0,5
ploughshare	1200	6,3	0,41	5,3	62,6	35,4	0,9	0,6	0,5

product E	m_{Batch}	angle of repose	piled weight	jolting chute	Retsch vibration sieve				
	kg	60mm	g/ml	min/200g	100µm	250µm	500µm	800µm	1000µm
Somakon	1	3,1	0,56	4	57,7	39,2	1,9	0,6	0,6
Screw mixer	250	3,2	0,56	4,1	58,8	37,9	1,9	0,9	0,5
Screw mixer	2500	3,1-3,3	0,54-0,58	4	56,9	40,8	1,3	0,5	0,5

Formulations

Because the products are out of current production, there can be given no exact data concerning the composition.

B. Production on screw mixer

Powders / liquids, the special attention is here with homogeneity, mixing factor and distribution of the liquids - freely flowing final product, defined particle size spectrum and the dust formation)

C Production on Nautamischer.

Powder, liquid and visible spice with the requirements as B, however with the requirement to achieve a homogeneous distribution of the filigrane visible spice without damaging in the structure.

D Production on Pflugscharmischer,

with the same requirements as B.

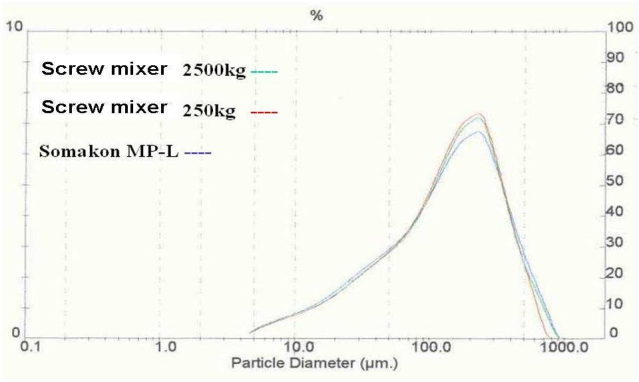
E. Production on screw mixer

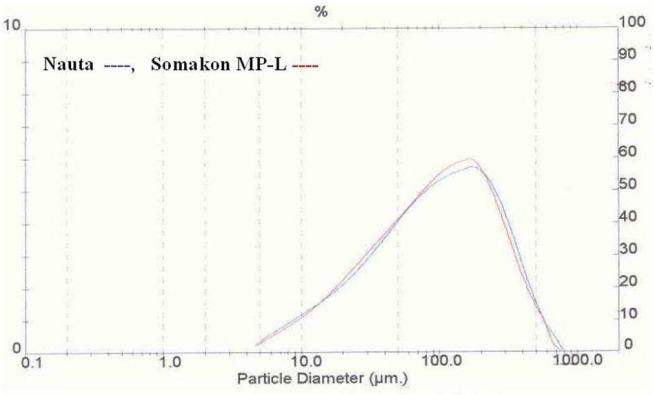
powder-powder-mixtures with both very fine and coarse particles.
With this formulation here lies the special attention to homogeneity and mixing factor.

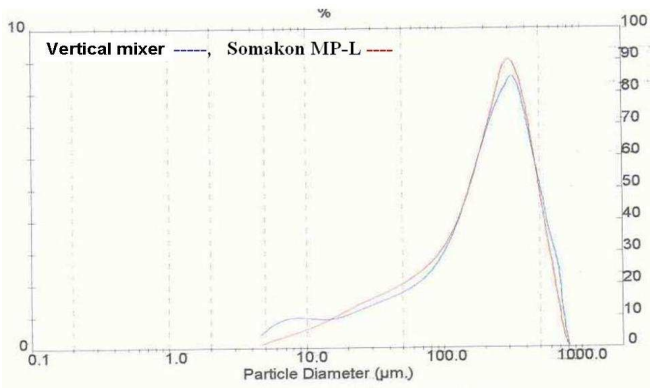
Results

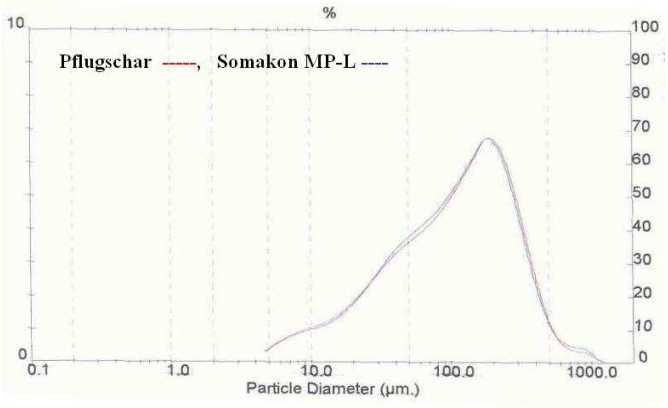
The mixing quality of all preparations was determined by the comparison of the color intensity and the salt concentration. In all cases the mixing quality was within the alleged tolerance frame.

With the 100g- preparations the rheologic investigations were abandoned for lack of mass. For safeguarding the characteristics of the 100g and the 1kg-mixtures (Malvern Laser diffraction measurement) were laid one above the other.
Comparison of the particle size distribution between laboratory- and production mixer (Malvern-Mastersizer):









Assessment:

The analysis values of the series of tests show a very consistent picture. The product qualities manufactured on the MP-L correspond in nearly all valuation criteria to the mixing quality out of production. With none of the trials significant deviations could be determined in the product quality / mixing quality. The deviations within the test series lie within the limits specified by quality control and the accepted tolerances by Symrise customers.

It is to mention that the temperature sequence of the product while mixing is in average around 4 to 5 ℃ lower with the Somakon - mixer when introducing mixing energy than with the production mixer.

To valuate the heat dissipation in dependence of proportion of mixer surface to mixer working tools surface to product volumes, the Somakon laboratory mixer was later equipped with a temperature survey of the product in the direct mixing process. The here observed effects even out after approx. 2 to 3 days "ripening time" / storage time of the product.

Result:

The Somakon MP-L laboratory mixer is very well suited for its task as simulation mixer.

The on the laboratory mixer accomplished process of producing product may be seen for the "Symrise specific" range as reproducible and transferable to the established mixer types.

The in the laboratory standard produced product samples on the Somakon mixer are classified as meaningful for an estimate and an evaluation of the expected mixing quality in a later production.

With different tools and process parameters different mixing systems can be simulated in the production.

With this the development- and process engineering departments receive a system on hand that can already point out in first steps of a product development formulation-, raw material- and product specific problems.

An early counter steering and adjusting of the formulation and manufacturing process is made possible, reduction of potential conversion- and production problems

Samples for sensor technology, application test, customer sampling and references for quality control show the desired approach to the later production quality.

The processes of the product development up to standardized production can be shortened temporally and arranged more effective.

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