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TEACHER NOTES

AC2. The function of anti-caking agents - a case study

The effect of Neosyl GP (silicon dioxide, E551) on the ability of Sainsbury's cocoa to flow is investigated.

The case study, on pupils sheet AC2, gives the procedures and results for an example investigation. You may prefer to replace the actual experiment AC1 with a discussion of AC2.

Neosyl GP (GP = general purpose) is an anti-caking agent. It is capable of improving the flow of many powders. Sainsbury's cocoa does not contain a free- flow agent. Other brands could be used as long as they too contained only cocoa.

Aim of the first part of the investigation: to determine the orifice size through which cocoa without Neosyl GP will not readily flow.

Aim of the remaining investigations: to determine the effect on the flow of cocoa with Neosyl GP added.

KS3 and 4 science

Timing - various

Two pupil activity sheets AC2 accompany this case study.

Investigation into the effect of Neosyl GP (silicon dioxide, E551) on the ability of Sainsbury's cocoa to flow

Method 1

1. Different sized funnels were prepared by removing 'stems'.
2. 100 g of cocoa was placed in the funnels.
3. The sides of the funnels were tapped to allow cocoa to flow through.
4. The number of taps required to remove all the powder was counted.
5. Each test was done 6 times and an average calculated.

Results: Cocoa without Neosyl GP

Orifice size	Number of taps						
mm	1	2	3	4	5	6	Average
50	4	4	2	2	2	2	3
40	2	1	1	7	3	3	3
30	44	20	20	21	21	23	25

On the basis of these results, the funnel with the 30 mm orifice was chosen for subsequent experiments as cocoa would not readily flow through this size.

Method 2

1. 100 g of cocoa powder was mixed with varying amounts of Neosyl GP so that the Neosyl GP was present as 0.1, 0.2, 0.3, 0.4, 0.5, 0.6 % by weight of the final mixture.
2. The mixing took place in a plastic bag. The two substances were placed in the bag and shaken vigorously.
3. Each mixture was placed in the funnel, as described before, and the number of taps needed to get all the powder through the funnel were counted. Each experiment was repeated 6 times.
4. One of the mixtures, the 0.3 %, was left for ~48 hours before carrying out the test.
5. A 0.6 % mixture was left for ~24 hours before being tested.

Results: Cocoa with Neosyl GP

Neosyl GP	Number of taps						
%	1	2	3	4	5	6	Average
0.1	23	25	25	19	19	20	22
0.2	27	23	20	16	17	19	20
0.3*	7	7	6	6	7	5	6
0.4	6	7	5	3	2	2	4
0.5	5	2	2	4	3	4	3
0.6	7	5	3	2	7	6	5
0.6**	3	2	2	2	2	4	3

* After an interval of ~48 hours

** After an interval of ~24 hours

Discussion: There appears to be a sudden improvement in flowability between the 0.2 and 0.3 % levels. It is not clear whether this is due to the increase in the level of the flow aid or to the fact that the mixture was allowed to stand for some time. Leaving the 0.6 % to stand seems to have improved its flowability. The experiment was repeated starting with the 0.4 % mixture.

Results: Cocoa with Neosyl GP, repeats

Neosyl GP	Number of taps						
%	1	2	3	4	5	6	Average
0	27	27	39	26	26	24	28
0.4	16	20	14	12	15	10	14.5
0.5	11	16	9	12	12	8	11
0.6	11	9	7	7	7	6	8
0.7	5	4	3	4	8	4	5
0.7*	1	2	2	1	2	1	1.5

* After ~48 hours

Discussion: These results show some variance with the previous results, some of which were supposed to be identical repeats. The results indicate that considerably more than the 0.3% Neosyl GP is needed to achieve good flowability. Leaving the mixture to stand for a while is again observed to result in improved flowability.

The experiment was repeated again with larger amounts of Neosyl GP.

Results: Cocoa with more Neosyl GP.

Neosyl GP	Number of taps						
%	1	2	3	4	5	6	Average
0	35	13	19	13	31	22	22
0.7	7	9	9	4	9	3	7
1.0	3	4	2	4	3	2	3

Discussion: It appears from the data that the maximum allowed dose of 1.0% Neosyl GP will almost make the cocoa entirely free flowing and that leaving the mixture to stand improves the flow.

The improvement in flow when left to stand may be due to the fact that the Neosyl GP is capable of absorbing fat. Cocoa has a fat content of ~20 %. The absorption of fat by the Neosyl GP may thus allow the particles of cocoa to flow more freely.

The action of an anti-caking agent can be demonstrated using ball bearings or something similar. If particles of the same size are within a container, they reach a point where they 'lock' together and become stationary. The addition of other spheres of different sizes has the effect of 'unlocking' the spheres so that they move again. Cocoa consists of small particles of similar size. The Neosyl GP consists of particles of a different size to the cocoa. Mixing of the two increases the mobility of the cocoa particles.