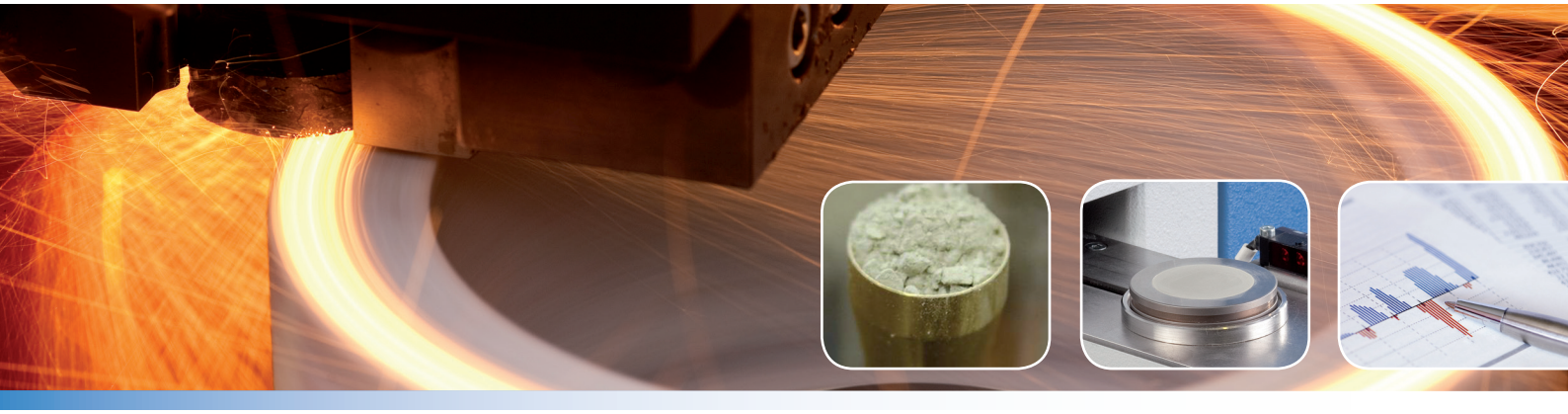


The linear sample splitting system

Abstract

This report summarizes the result of tests done to evaluate the accuracy and precision of the HERZOG linear splitter system. These results reveal that the HERZOG splitter produces representative subsamples from a primary lot with sufficient accuracy and precision. We show that the grade of precision was determined by the material properties of the sample whereas accuracy was influenced by the hardware setting.

Keywords

Mass reduction • sub-sampling • linear splitting system • accuracy • precision

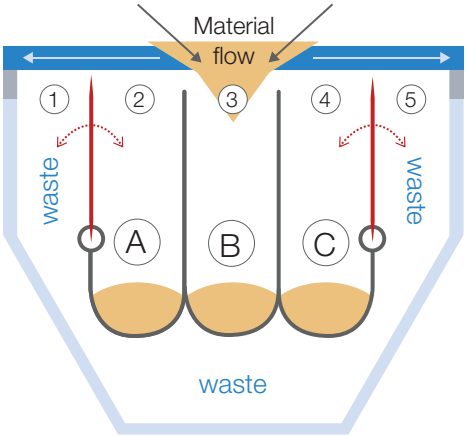
Introduction

Representative sampling and mass reduction is one of the major concerns in sample preparation. Automation of the mass reduction process reduces potential error sources and consequently decreases the “total sampling error”. Therefore, HERZOG is offering a sample splitter which is especially designed for operation in automatic mode. The linear splitting system is capable of creating subsamples for a wide range of different raw materials and products. Using the HERZOG system, mass reduction can be adjusted according to the analytical demands and circumstances. The linear splitting unit provides the possibility to obtain up to three sub-samples from a “primary lot”. For each of those subsamples, a specific volume/mass can be defined independent from the input mass of the sample.

Here, we investigated the accuracy and precision of the HERZOG linear splitting system during mass reduction and production of representative subsamples. For the test series we used an artificial sample containing various material types with different grain sizes.

Hardware

The material transport into the splitting unit is realized by a vibration feeder providing a constant material flow during the splitting process. The splitting unit itself consists of a sliding carriage which is moving over the sampling chambers. Two of those sampling chambers can be closed with a flap. This allows that the number of subsamples can be changed during automatic operation according to the sampling schedule, by applying different preset splitting programs stored in the software settings (see Figure 1).



1 Waste chamber
2 Sample chamber (sample cup A)
3 Sample chamber (sample cup B)
4 Sample chamber (sample cup C)
5 Waste chamber

Fig.1: General setup of the splitting chamber used in the test.

Sample material

The selected sample materials were chosen in order to cover a broad range of possible effects (like e.g. flow segregation) which may occur during material transport and subsampling. The artificial sample contained three different materials with different properties representing major and trace components of a natural system. The artificial sample was mainly composed of phosphate concentrate (89.00 %) and two minor phases. The phosphate concentrate was derived from nepheline syenite rocks of the Kola Peninsula. The phosphate concentrate was screened to remove the size fraction bigger than 500 µm. The two minor phases consisted of blast-furnace slag (10.00 %) and glass spheres (1.00% or 10.000 ppm) (see Figure 2). The slag was screened several times to remove the particles smaller than 2 mm. The slag particles were chosen because they had a high variability in particle shape ranging from round shape to platy elliptic. The glass spheres had a diameter between 0.75mm and 1 mm. The chosen composition allowed a quick separation of all fractions by simple dry screening.

Fig. 2: Overview of the material used for the artificial sample used for the splitting test.
(A) slag (>2 mm), (B) phosphate concentrate (<500 µm), (C) glass spheres (1 mm – 0.75mm)

Methods and Parameters

In a first step (part A) the accuracy of the splitting process was evaluated, i.e. the accuracy in dosing the desired mass of each subsample. For this purpose we used only the phosphate concentrate.

In a second step (part B) we assessed whether sample splitting was representative. For this purpose we used the artificial sample composed of all three fractions. For each test a new sample was created by weighing each fraction with a total precision of ±0.3g. After weighing, the sample was shaken vigorously for 1 minute in a closed container. Afterwards, the sample was poured manually into the input funnel. As target values for the subsamples, the following setting was chosen:

Cup 1 with 30 g, Cup 2 with 30 g and Cup 3 with 90 g.

Additionally to the normal sample cups, the waste material was collected in a bucket.

Results

Part A

For part A the input weight was 500 g sample material. The sample was tested with the following parameters:

- Fixed splitting time: 120 sec
- Weight depending splitting time: 300 sec/ kg
- Cup 1/2/3: 30 g / 30 g / 90 g
- Vibration intensity: 3

The splitting tests showed that the deviation from the desired subsample mass was very low with a maximum deviation of approximately 1 g for the total mass of split subsamples (Table 1).

	30g	30g	90g	SUM
1	29.36	30.43	91.84	151.63
2	29.13	30.41	90.05	149.59
3	29.01	30.70	91.48	151.19
4	29.23	30.05	91.87	151.15
5	29.96	30.64	91.07	151.67
6	29.61	30.93	91.10	151.64
Average	29.38	30.53	91.24	151.15
Max	29.96	30.93	91.87	151.67
Min	29.01	30.05	90.05	149.59
Standard deviation	0.35	0.30	0.68	0.80

Tab.1: Accuracy of the obtained masses for splitting six times a 500 g sample into a 30 g, 30g and a 90 g sub-sample.

Part B

For Part B the input weight was 500 g material. The sample was tested with the following parameters:

- Fixed splitting time: 20 sec.
- Weight depending splitting time: 130 sec/ kg
- Cup 1/2/3: 30 g / 30 g / 90 g
- Vibration intensity: 3

The composition of the subsamples was similar identical to the composition of the primary lot without any significant deviations as shown by the average weight percentage (Table 2 and Figure 3). The standard deviation of all sample fractions was low with the least variation for the glass spheres (Table 2).

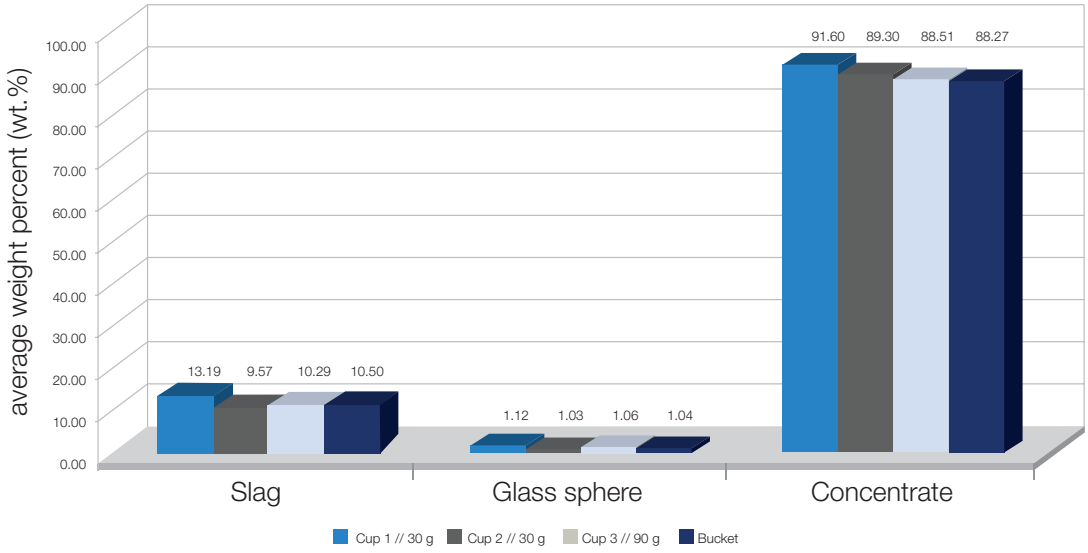


Fig. 3: Average concentration of each component refers to 20 splits.
The target value for the slag is 10.00 wt. %, for the glass spheres 1.00 wt. % and for the concentrate 89.00 %.

Cup 1 // 30 g

	Slag	Glass sphere	Concentrate
target value	10.00	1.00	89.00
Min	7.36	0.93	85.67
Max	13.19	1.12	91.60
Average	10.18	1.00	88.83
Stand. Dev.	1.52	0.05	1.51

Cup 2 // 30 g

	Slag	Glass sphere	Concentrate
target value	10.00	1.00	89.00
Min	6.78	0.94	86.26
Max	12.68	1.22	92.18
Average	9.57	1.03	89.30
Stand. Dev.	1.39	0.06	1.34

Cup 3 // 90 g

	Slag	Glass sphere	Concentrate
target value	10.00	1.00	89.00
Min	8.75	0.99	86.64
Max	11.32	1.11	90.14
Average	10.29	1.06	88.51
Stand. Dev.	0.61	0.04	0.76

Bucket

	Slag	Glass sphere	Concentrate
target value	10.00	1.00	89.00
Min	10.03	0.99	84.69
Max	11.18	1.09	88.94
Average	10.50	1.04	88.27
Stand. Dev.	0.30	0.03	0.90

Tab. 2: Main important statistic values for each sample container obtained from 20 samples processed.

Discussion

These results demonstrated a sufficient accuracy and precision of the HERZOG splitter. The arithmetic mean as a measure for accuracy was constant for all sample cups and sample components. These tests showed that the linear splitter is capable of dosing subsamples with an accuracy of ± 1 g.
The precision varied slightly subject to the material and sample volume without significant differences to the primary lot and between the different subsamples.

Conclusion

The test demonstrated that the HERZOG linear splitting system creates representative subsamples from a primary lot. The splitting result depends on the sample material and its specific characteristic like grain size distribution and particle shape. Also the sample volume which is inserted in the splitter influences the performance of the system.

For further questions please contact us.

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