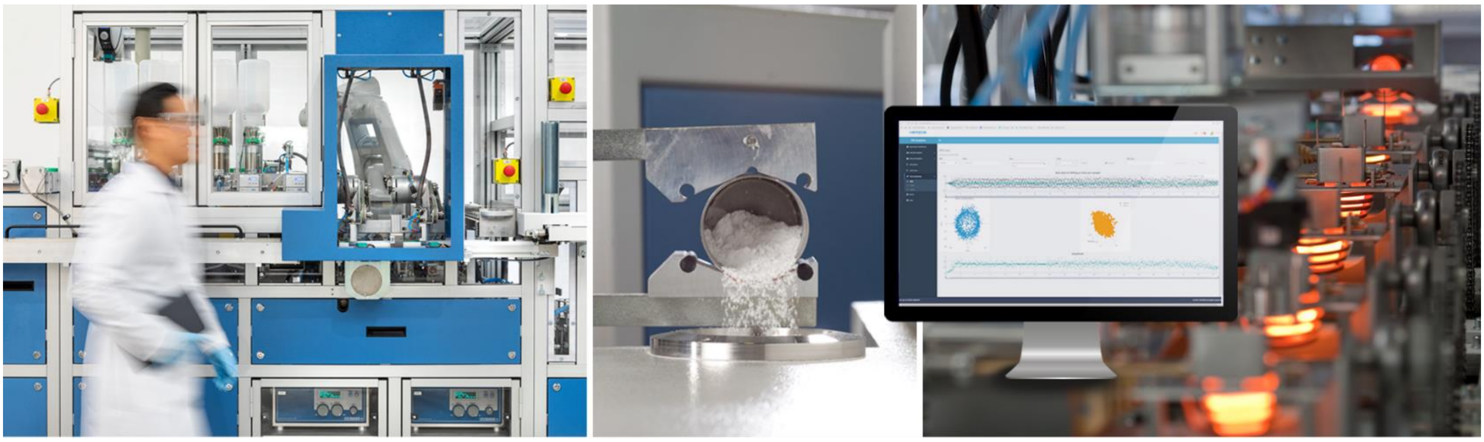
HERZOG



Representative Division of Iron Ore Samples Using the HERZOG HP-RSD/L Rotary Sample Divider

Abstract

This application note evaluates the performance of the HERZOG HP-RSD/L rotary sample divider for mass division of iron ore fines in accordance with ISO 3082. Iron ore fines with a nominal top size below about 10 mm were divided at input masses between 12.5 kg and 140 kg, while the average mass flow rate and peripheral speed of the drum (0.6 m/s, 10.6 rpm) were kept constant. Split ratios were determined for three 25 % and two 12.5 % bins using the integrated load cell of the HP-RSD/L. Mean split fractions closely matched the nominal targets, and the coefficients of variation ranged from 0.9 % to 2.6 %. These results demonstrate constant mass division well within the ISO 3082 requirement and robust performance across the tested mass range. This confirms the HP-RSD/L as a highly reliable division stage for automated mining and port laboratories.

Key words

• Iron ore • Constant mass division • ISO 3082 • Rotary sample divider HP-RSD/L •

Introduction

Reliable sampling and sample division of iron ore fines are essential for process control and for fulfilling contractual obligations in international trade. Small systematic errors introduced during mass reduction cannot be corrected at the analytical stage and may lead to biased evaluations of ore quality. The international standard ISO 3082 therefore defines the basic principles and requirements for design and operation of sampling and sample preparation systems for iron ores, including the concept of representative sampling, constant-mass division and control of sampling bias.

In many practical installations, bulk samples of several tens or even hundreds of kilograms must be reduced to analytically manageable masses by mechanical division. HERZOG's HP-RSD/L rotary sample divider is designed for large-volume secondary and tertiary splitting of iron ore and other bulk materials and is widely used in automated mining and port laboratories, for example for quality control of iron ore cargos before ship loading or after discharge. In this application note, we evaluate the representativeness of dividing iron ore fines in the HP-RSD/L by assessing the accuracy and repeatability of the achieved split ratios over a broad range of initial sample masses. We also discuss the results in the context of the requirements of ISO 3082.

Figure 1: HP-RSD/L equipped with three hoppers on the top for sample compositing.

Methods

The performance of the HP-RSD/L rotary sample divider was evaluated using iron ore fines (nominal top size typically below 10 mm). For all tests, material with low residual moisture was used to minimize the influence of sticking or build-up on the split behavior.

Tests were carried out with various input masses between approx. 12.5 kg and 140 kg,

Figure 2: Photo showing the material stream of iron ore on the conveyor belt above the division drum.

covering the typical operating range of the HP-RSD/L in industrial applications.

For each test, the feed duration was adjusted between 2.5 and 4.3 min such that the average mass flow rate into the divider remained approximately constant across all runs (Figure 2).

The HP-RSD/L was operated with its standard configuration of three nominal 25 % and two nominal 12.5 % collection bins. The peripheral speed of the rotating dividing drum was set to 0.6 m/s, corresponding to a rotational speed of 10.6 rpm for the drum. For each test, the feed was continued long enough to achieve at least 25 complete revolutions (cuts) of the drum while the material stream was present (Figure 3). This guaranteed sufficient averaging of any short-term fluctuations in mass flow and particle composition.

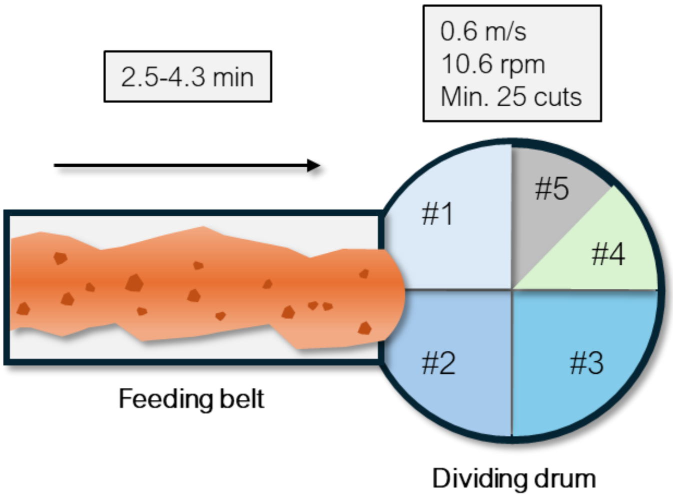


Figure 3: Schematic representation of the HP-RSD/L rotary sample divider. Iron ore fines are fed via conveyor belt into a rotating dividing drum with five segments (#1–#5). The parameters used are shown in the grey boxes.

All masses were measured using the integrated load cell of the HP-RSD/L. After each test, the material collected in each of the five bins was weighed individually. The split fraction for each bin and test was calculated as the ratio of the bin mass to the total mass discharged into the divider. For each bin position, the mean split fraction, standard deviation and coefficient of variation (CV) were then calculated over the tests.

Results

Over all tests, the mean split ratios (mean ± SD) were 24.8 ± 0.2 %, 24.8 ± 0.3 % and 24.6 ± 0.4 % for the three 25 % positions, and 12.7 ± 0.2 % and 12.6 ± 0.3 % for the two 12.5 % positions. Expressed as coefficients of variation (CV), the variability of the individual bins ranged from 0.9 % to 2.6 % (Table 1). No systematic dependence of the split ratio on the initial sample mass was observed; deviations from the nominal 25 % / 12.5 % targets fluctuated randomly around the set values.

Discussion

ISO 3082 aims to ensure that iron ore samples are representative, meaning all parts of the lot have an equal probability of selection. For mass-based division, it specifies constant mass division, defined by "almost uniform" portion masses, quantitatively expressed as a coefficient of variation (CV) below 20 % for the masses of the divided fractions.

In our tests with three 25 % and two 12.5 % positions, the mean split ratios (24.8 %, 24.8 %, 24.6 %, 12.7 %, 12.6 %) were very close to the nominal fractions, and the CV values ranged only from 0.9 % to 2.6 %. The HP-RSD/L therefore exceeds the ISO 3082 requirement for constant mass division by a wide margin. Neither the mean split ratios nor the CV values showed a systematic dependence on input mass between ~12.5 kg and 140 kg, indicating robust performance across the full tested range. This is an important advantage in automated mining and port laboratories with varying gross sample masses.

The HP-RSD/L is designed as a large-volume rotary divider for secondary and tertiary splitting of iron ore and other bulk materials, with fixed split ratios and steep internal surfaces to promote uniform discharge and minimize build-up. While this study evaluates mass-based performance rather than analytical results, constant mass division is a necessary precondition for representative sampling under ISO 3082.

The very low CV values obtained here show that the HP-RSD/L behaves as an almost ideal mass-reduction device; remaining uncertainty in analytical results will predominantly arise from upstream sampling and downstream analysis, not from the rotary division step.

	Pos #1 (25 %)		Pos #2 (25 %)		Pos #3 (25 %)		Pos #4 (12.5 %)		Pos #5 (12.5 %)	
Input weight (kg)	Sample (kg)	Split (%)	Sample (kg)	Split (%)	Sample (kg)	Split (%)	Sample (kg)	Split (%)	Sample (kg)	Split (%)
12.529	3.118	24.9	3.130	25.0	3.020	24.1	1.590	12.7	1.514	12.1
24.708	6.072	24.6	6.148	24.9	5.94	24.0	3.167	12.8	3.256	13.2
24.781	6.073	24.5	6.197	25.0	6.081	24.5	3.092	12.5	3.121	12.6
24.795	6.195	25.0	6.004	24.2	6.136	24.7	3.211	12.9	3.110	12.5
49.804	12.184	24.5	12.436	25.0	12.361	24.8	6.244	12.5	6.217	12.5
100.000	24.810	24.8	24.781	24.8	24.994	25.0	12.649	12.6	12.529	12.5
140.000	35.016	25.0	34.772	24.8	35.311	25.2	17.603	12.6	17.771	12.7
Mean ±SD		**24.8 ±0.2**		**24.8 ±0.3**		**24.6 ±0.4**		**12.7 ±0.2**		**12.6 ±0.3**
CV (%)		**0.9**		**1.1**		**1.8**		**1.2**		**2.6**

Table 1: Results of the splitting tests performed with the HP-RSD/L. The first column lists the input masses of the test samples. The color-shaded columns show the absolute masses of the subsamples and the corresponding split ratios in percent. The last two rows summarize the mean split fractions including standard deviation (SD) and the coefficients of variation (CV) for each bin.

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