

AUTOMATIC WEIGHING INSTRUMENTS PRODUCT CIRCULATION TEST SYSTEM

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Abstract:

This paper describes a kind of automatic weighing instruments product circulation test system. The system is composed of four conveyor belts and four hopper weighers which adopts the “M” type cycle architecture and the principle of superimposed control weighing instruments. Through this system, we can carry out the product test of belt weighers, automatic gravimetric filling instruments and totalizing hopper weighers. Most importantly, this system can carry out the durability test of belt weigher.

Keywords: belt weigher; product test; durability

1. INTRODUCTION

The product test of automatic weighing instruments is usually carried out on the use site [1]. The following problems exist in this test method: changing environment, unstable working condition of equipment and potential safety hazards, all of these will lead to the reduction of controllability and accuracy of the test [2], [3]. Annex C of OIML R 50 gives the requirements for durability test [4] about type approval and subsequent metrological control, however, no specific test method is given. We believe that this is because there was no standard and stable product test device at that time, so it was impossible to carry out long-term durability test on site.

2. DESCRIPTION OF THE WORK

2.1. General Introduction

The test system is mainly composed of four belts, four hopper weighers, conveyor belt, multiple motors, system control cabinet, central control room, fixed supports etc. The laboratory is 70 m long, 30 m wide and 20 m high, with an overall area of 2 100 m². Twenty temperature and humidity sensors are installed at key positions of the laboratory to monitor environmental conditions. The belt information is shown in Table 1.

Table 1: Belt information

No	Belt width / m	Belt speed / m/s	Belt length / m
1	1.8	1.25 to 5.0	60
2	1.4	1.25 to 5.0	60
3	1.0	1.25 to 5.0	60
4	0.4	1.25 to 5.0	60

The hopper weighers information is shown in Table 2. Among them, the top three are control instruments and have been equipped with 62 t standard weights which they can lift automatically to calibrate themselves (medium accuracy), and the fourth (20 t) is buffer hopper.

Table 2: Hopper weighers information

No	Capacity / t	<i>d</i> / kg	Accuracy Class
1	10	2	ⒸIII
2	90	20	ⒸIII
3	100	20	ⒸIII
4	20	5	/

The system is equipped with 100 t manganese ore particles. The conveying cycle of products can be completed through four belts and four hopper weighers. The system can meet the measurement requirements of belt weigher with flow range from 400 t/h to 4 000 t/h. Figure 1 is the structural diagram, and the whole system is arranged in an “M” shape [5].

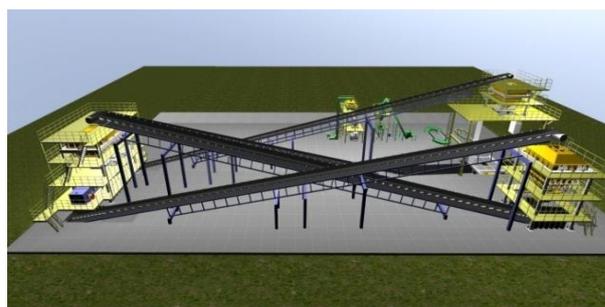


Figure 1: “M” structural diagram

In order to save installation space, the belts are installed obliquely in most of the use sites in China. The inclination angle of belt is 10° to 13° , the manufacturers of belt weighers have mature experience in the correction and calibration of tilt position now. The installation position of the belt weigher is generally about 15 m away from the starting conveying position of the belt at the unload point, that is, about one fourth of the whole belt (60 m). Figure 2 is the physical picture of the site.



Figure 2: The physical picture of the site

The test system can carry out product test of belt weigher, totalizing hopper weigher and automatic gravimetric filling instrument. The main applicable product specifications are shown in Table 3.

Table 3: Main applicable product specifications

Product	Capacity	Accuracy Class
Belt weigher	(400 to 4000) t/h	0.5 to 2
Totalizing hopper weigher	(1 to 10) t	0.5 to 2
Automatic gravimetric filling instrument	(1 to 10) t	X(0.5) to X(2)

2.2. Test Procedure for Belt Weighers

No. 1 and No. 2 Belt Weighers

Most products will be stored in the hopper weigher (100 t) normally, when we open one of the sluice of the hopper weigher (100 t), products will be transported to the No. 1 belt, then it will get to the hopper weigher (90 t) after weighing by the belt weigher 1 installed on No. 1 belt, before we begin the next test, the No. 2 belt will transport the products back to the hopper weigher (100 t), if another belt weigher is installed on the No. 2 belt, we can complete the product test of belt weigher 2 in the process of returning products. We can get the true quantity value of products through the hopper weighers (100 t or 90 t). So we call it product circulation test. The system can change the flow

through adjusting the belt conveyor and the degree opening of the sluice. This is shown in Figure 3 [2].

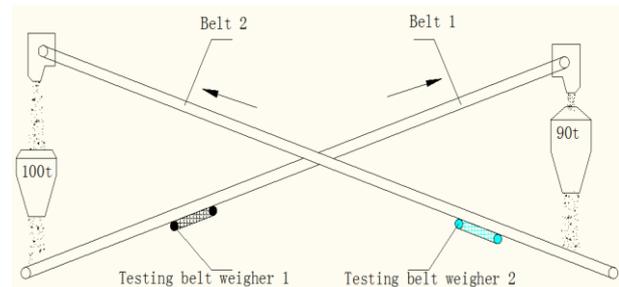


Figure 3: No. 1 and No. 2 belt operation diagram

No. 3 and No. 4 Belt Weighers

If the belt weigher 4 is installed on the No. 4 belt, the products of the hopper weigher (100 t) will open the other sluice, then the products will be transported to the No. 4 belt, then it will get to the hopper weigher (20 t, just a buffer hopper, not control instrument) after weighing by the belt weigher 4, if Σ_{\min} [1], [6] is larger than 20 t, the buffer hopper could unload part of products to the hopper weigher (10 t, underground) through the special chute. When the hopper weigher (10 t) opens the sluice, the No. 3 belt will transport the products back to the belt weigher (100 t), if another belt weigher is installed on the No. 3, we can complete the product test of belt weigher 3 in the process of returning products.

Then we have two methods to get the true value of products: we can either read the indication of the hopper weigher (100 t) if its uncertainty meets the requirements of OIML R 50 or, if its uncertainty does not meet these requirements, we can read and add the indications of the hopper weigher (10 t) - it may be that this will need several weighings. This is shown in Figure 4.

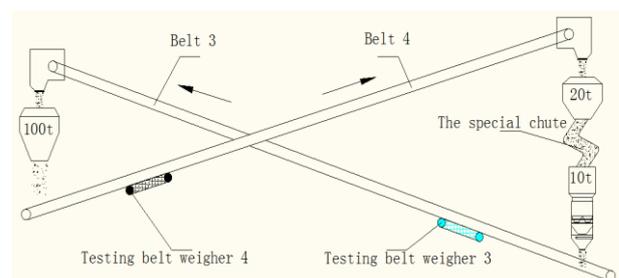


Figure 4: No. 3 and No. 4 belt operation diagram

Other Automatic Weighing Instruments

The totalizing hopper weigher or automatic gravimetric filling instrument will be installed on the mobile platform which can be moved above the hopper weigher (10 t). The automatic weighing instrument (AWI) measured could connect with the hopper weigher (20 t) closely through the special chute.

The products of the hopper weigher (20 t) will drop on the instrument measured continuously, after

completing one weighing cycle the instrument measured will transport products to the hopper weigher (10 t). If the loads are less than 10 t, we can get the true quantity value of the products through the hopper weigher (10 t). If not, we can read and add the indications of the hopper weigher (10 t) several times, just each time the instrument measured should stop until No. 3 belt transports the products back to the belt hopper (100 t), the No. 4 belt could transport products to the buffer hopper (20 t) continuously. This is shown in Figure 5.

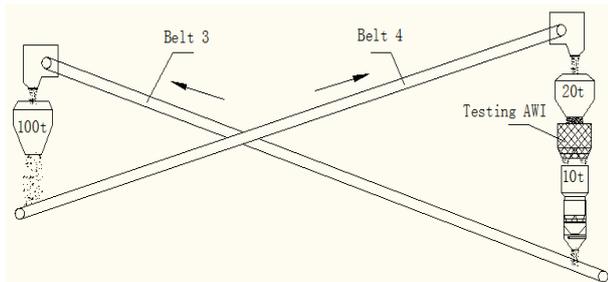


Figure 5: Totalizing hopper weigher or automatic gravimetric filling instruments test diagram

3. DURABILITY TEST

In 2020, four belt weighers operate for four hours a day for six months. The main information of belt weighers is shown in Table 4.

Table 4: Belt weighers information

No.	Q_{max} / (t/h)	Accuracy Class	v / (m/s)	d_t	Σ_{min} / t
1	600	1	5	1	12
2	1 000	1	5	1	20
3	2 000	1	5	10	40
4	3 000	1	5	10	60

The product test is conducted once a month. The test errors are shown in Table 5.

Table 5: Belt weighers information

Date	Belt 1 E / %	Belt 2 E / %	Belt 3 E / %	Belt 4 E / %
February 6	0.31	0.35	0.36	0.39
March 8	0.31	0.35	0.36	0.41
April 7	0.34	0.37	0.37	0.41
May 6	0.36	0.38	0.38	0.43
June 5	0.38	0.40	0.37	0.45
July 6	0.40	0.41	0.38	0.46

It can be seen from Table 5 that the product test error of each belt weigher increases with the increase of running time, but the durability performance of each instrument is different. Obviously, No. 3 belt weigher has the best durability in these six months.

Next, we will carry out a longer-time durability test (more than one year), continue to accumulate test data, and find out the key factors affecting the durability of the belt weigher.

4. SUMMARY

From 2014 to 2021, a total of 45 belt weighers of different models and specifications have conducted product tests on this system. In addition, four belt weighers have conducted durability tests on this system for up to 6 months.

The test system can carry out the product circulation test of belt weighers, automatic gravimetric filling instruments and totalizing hopper weighers in an integrated way. The environment and equipment are stable and controllable. According to OIML R 50, the test system truly realises the durability test of belt weighers.

5. REFERENCES

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