

HOT
Process For Environment

Sensor-based & Water-free XRT Intelligent Ore Sorter

HOT (CHENGDU) INDUSTRIES CO LTD

- Highest precision
- Largest range of particle
- Available for most of raw ores





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XRT



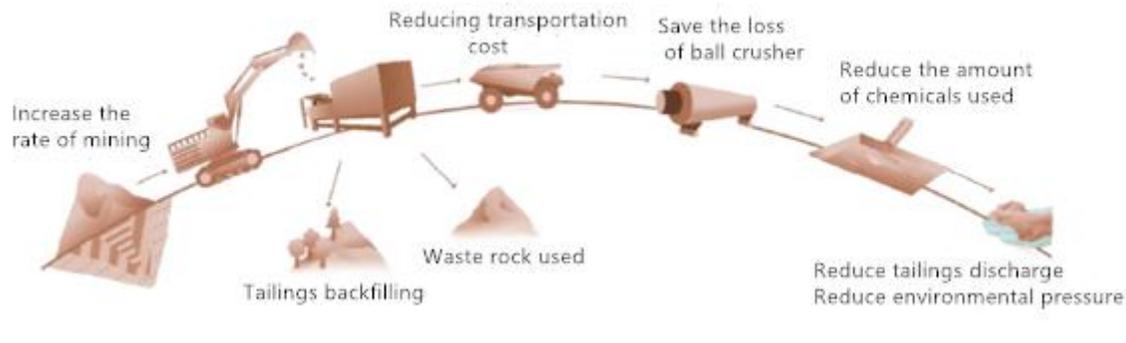
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Background

Why we study XRT?

XRT Intelligent Sorting Technology-Value in Mining Industry

Through the intelligent sorting technology of XRT, the grade of selected ore can be improved, a large amount of waste rock can be discarded, and valuable minerals in tailings and slag can be recovered and reused, so as to reduce the processing cost of downstream processes (crushing, grinding, flotation, etc.), greatly improve the mine efficiency and economic benefits, and extend the mine life. It can be widely used in all kinds of mines, including precious metals, nonferrous metals and other minerals, such as gold, silver, molybdenum, copper, zinc, tungsten, vanadium and so on.



The intelligent sorter can effectively improve the efficiency of every link in the mining process and reduce the pressure of environmental protection while greatly reducing the cost of mineral processing.

Introduction

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What is the XRT?



XRT Intelligent Sorting - Working Principle

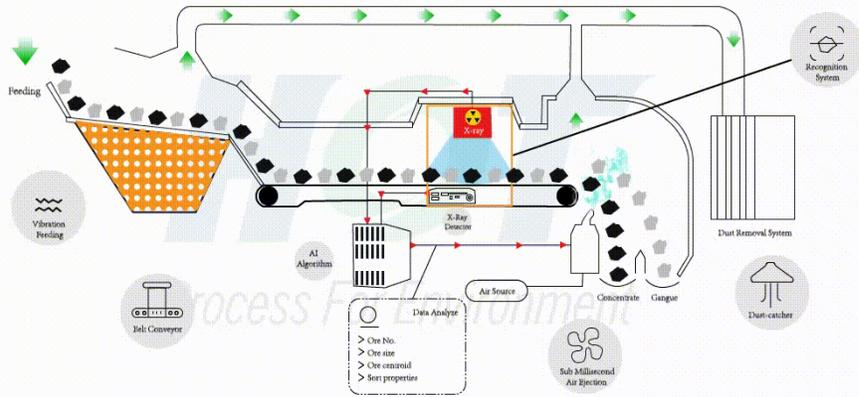
Working Principle

Based on the X-ray and sensor, the XRT Intelligent Sorter scans the raw ore with X-rays and collects data from the detector. With the help of big data analysis and intelligent algorithms, the ore and waste rock was identified and the high-pressure blower sprays waste stone away to realize efficient automatic intelligent sorting.

ORE SORTING

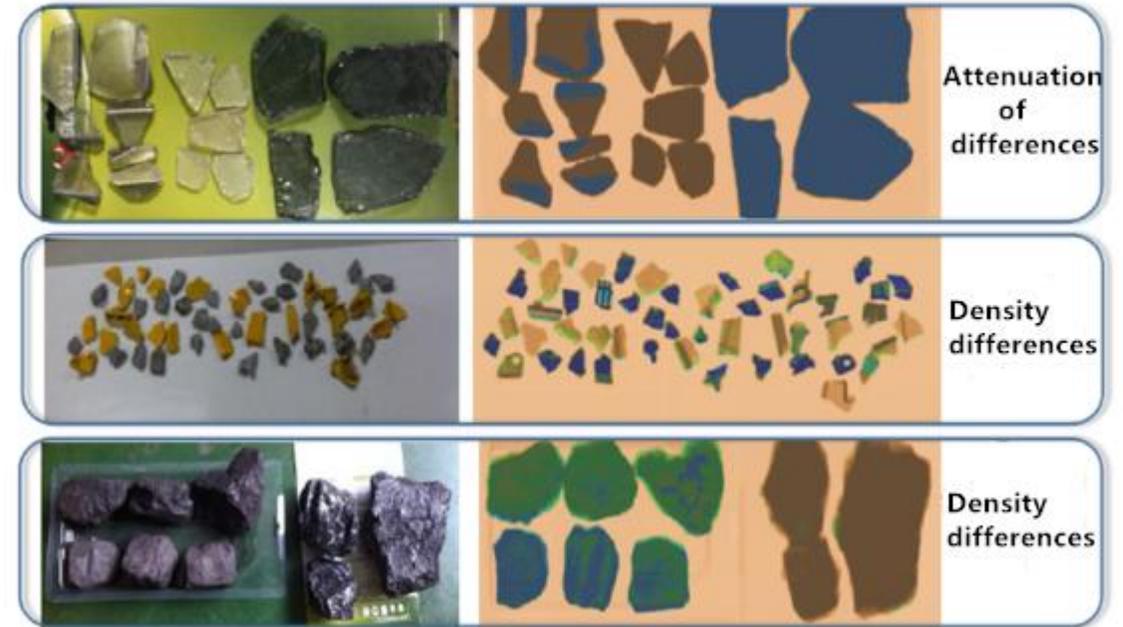
XRT Intelligent Sensor Based Ore Sorter

SorterX 浩特(成都)智能科技有限公司
HOT (Chengdu) Industries Co., Ltd



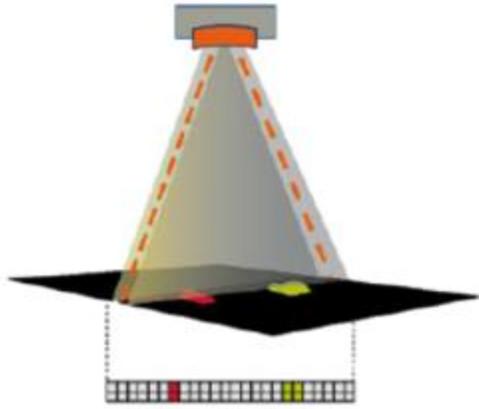
XRT Intelligent Sorting-Identifying Principle

		Sensor Technology	Materials Characterization	Applicable to mineral
Gamma ray	【m】 10 ⁻¹² 10 ⁻¹¹	RM (radiation method)	Natural gamma rays	Uranium, precious metals
X-ray		XRT (x-ray transmission)	Atomic density	Common/precious metals, coal, diamond
Ultraviolet (LV)	10 ⁻⁹ 10 ⁻⁸ 10 ⁻⁷	XRT (x-ray transmission)	X-ray visible fluorescence	Diamond
Visible light (VIS)	10 ⁻⁶ 10 ⁻⁵ 10 ⁻⁴	COLOR(CCD colour camera)	Reflection, Brightness, Transparency	Common/precious metals, industrial mineral, diamond
Near-infrared (NIR)	10 ⁻³ 10 ⁻² 10 ⁻¹	PM (Spectrophotometry)	Monochrome reflection / absorption	Common metal, diamond
Infrared ray (IR)		NIR (Infrared spectrometry)	Reflection, Absorption	Common metal, industrial mineral,
Microwave	10 ⁻¹ 10 ⁻² 10 ⁻³	IR (off line cam)	Thermal conductivity, heat dissipation	Common metal, industrial mineral
Electromagnetic wave	10 ⁻³ 10 ⁻⁴	MW (Heating combined with infrared analysis)	Sulfide and metals heat up faster than other minerals	Common/precious materials
Alternating current(AC)		EM(Electromagnetic sensor)	Conductivity	common metal



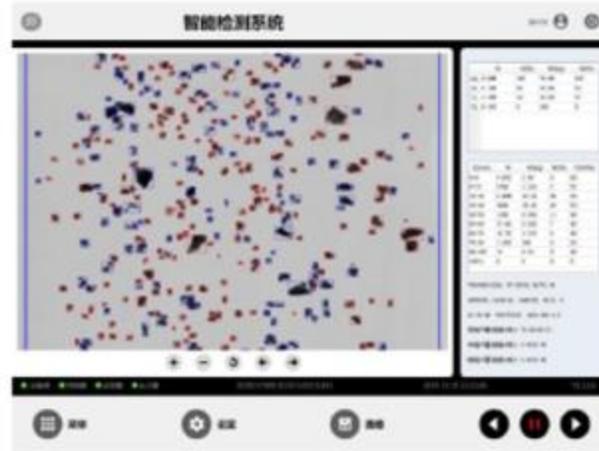
The penetrating power of X-rays is related to the density of substances. The attenuation strength of X-rays after passing through this substance is different, so that substances with different densities can be distinguished.

XRT Intelligent Sorting-Core Technology



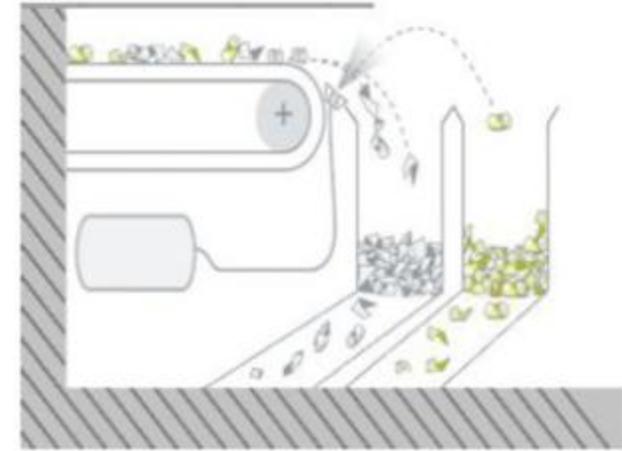
XRT High precision sensor system

- Independently developed detector
- High resolution imaging



Real - time intelligent substance identification

- Self-developed algorithm software
- Multi-dimensional modeling, fast recognition



Automatic high speed injection separation

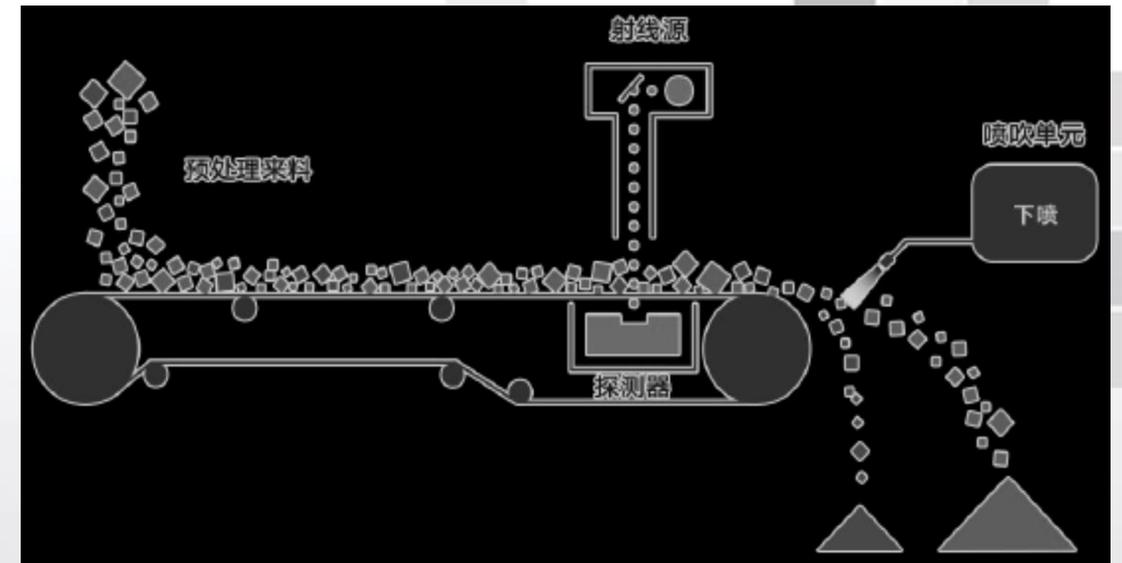
- Self-developed injection control
- Sub-millisecond response time

XRT Intelligent Sorting-System Structure

XRT Intelligent Sorting System

The main components of the intelligent ore separation machine, according to the structure of each part, can be divided into the following 4 parts:

- Feeding System: convey the ore so that the ore enters the detection area steadily and stably.
- Detection System: is the core part of the ore separation equipment
- Signal Processing System: high-speed processing of the characteristic information obtained by the detection system, using artificial intelligence algorithms to analyze and identify the ore images and data, and decide whether to spray the waste rock.
- Sorting and Execution System: The target ore can be sprayed away from the original route by using the high pressure gas discharge gun as the power to achieve the purpose of sorting.



XRT Intelligent Sorting-Equipment Parameter

The effective sorting range of XRT Intelligent Sorting Machine is + 8-300mm, the single processing capacity can reach 40 ~ 380t / h (width-speed-particle size, divided into **small: 40-70t / h; medium: 50-150t / h; large: 70-380t / h**), is currently the only domestic non-ferrous metal, ferrous metal, non-ferrous Both metals and coal mines have practically applied highly efficient and environmentally friendly intelligent ore sorting equipment. According to the actual calculation of the mine, the waste disposal rate can reach as high as 88%, the waste disposal rate for the original mine can reach 30 to 60%, and the metal recovery rate can reach up to 99%.

Project	Content	Note
Crude ore	Suitable for primary coal crushing. Suitable for tungsten, tin, antimony, lead and zinc, copper, gold, silver, molybdenum and other metallic minerals and fluorite, phosphorus, sulfide and other non-metallic minerals.	
Separation principle	XRT	X - ray transmission technology
Particle size range	It is can select a variety of ranges according to different requirements. Include : +8-40mm, +12-60mm, +20-100mm, +50-300mm	
Output	40-400t/h. It is determined by raw ore, belt speed and so on.	
Size of Host Machine	9*2.3*2.5(m)	
Weight	10(t)	
Rate of work	<10KW	



Model Table of 300-50mmTXS Intelligent Sorter

Technical Specifications	TXS10-305	TXS12-305	TXS14-305	TXS16-305	TXS18-305	TXS20-305	TXS24-305	TXS28-305	TXS30-305
Effective Separation Width (mm)	800	1000	1200	1400	1600	1800	2200	2600	2800
Processing Capacity(t/h)	80	100	120	140	160	180	220	260	300
Feeding Size(mm)	300~50	300~50	300~50	300~50	300~50	300~50	300~50	300~50	300~50
Supporting Plant Type(Mt/a)	<1.5	1.5~2.0	2.0~2.5	2.5~3.0	3.0~3.5	3.5~4.0	4.0~4.8	4.8~5.5	5.5~6.5
Remarks: 1、 The separation accuracy is better than Movable Sieve Jig; 2. 300-50mm yield is calculated at 25%.									

Model Table of 100-25mmTXS Intelligent Sorter

Technical Specifications	TXS10-102.5	TXS12-102.5	TXS14-102.5	TXS16-102.5	TXS18-102.5	TXS20-102.5	TXS24-102.5	TXS28-102.5	TXS30-102.5
Effective Separation Width (mm)	800	1000	1200	1400	1600	1800	2200	2600	2800
Processing Capacity(t/h)	48	60	72	84	96	108	132	156	180
Feeding Size(mm)	100~25	100~25	100~25	100~25	100~25	100~25	100~25	100~25	100~25
Supporting Plant Type(Mt/a)	<0.9	0.9~1.1	1.1~1.3	1.3~1.5	1.5~1.7	1.7~1.9	1.9~2.4	2.4~2.8	2.8~3.2
Remarks: 1、 The separation accuracy is better than Jig; 2、 100-25mm yield is calculated at 30%.									



PART
3

Advantages

What are the advantages of XRT?

Technology Advantage-Detector and Algorithm

HOT -XRT Intelligent Sorter

The signal-to-noise ratio of the X-ray detector is world-class, and the low-power ray source can obtain a sufficiently good X-ray image

Self-learning AI Algorithm

In-depth understanding of the spectral characteristics of X-rays after ore penetration effectively removes the effect of thickness on recognition

Detection Accuracy

Self-developed detectors can be specially customized and deeply optimized.

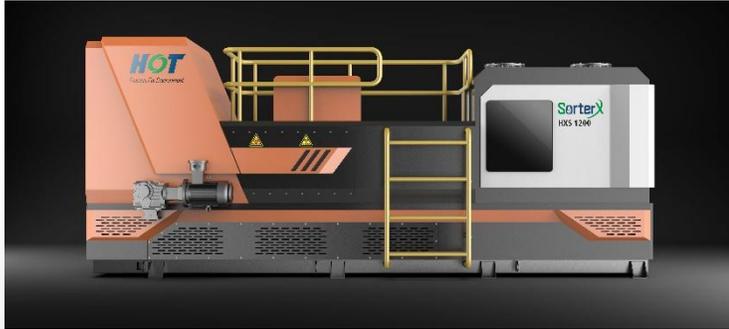
It has a full range of X-ray detectors with different resolutions and different energy spectrum bands. Increase recognition accuracy and improve sorting accuracy

Injection Direction

Solved the technical problem of spraying from bottom to top, and the spraying equipment has been put into application, which can be sprayed at multiple angles; predict the trajectory and accurately injection.



Technology Advantage-Hight Speed and Production



Detector acquisition speed:
Self-designed ultra-high speed ray detector system with sampling frequency up to 12KHz is the fastest in the world



Algorithm recognition speed:
International leading high integration based on hardcore logic. AI algorithm, to achieve the millisecond computing rate



Fast and accurate controlled injection:
Embedded system exquisite control, to achieve sub-millisecond response speed

Collection + operation + execution, the three links run at ultra-high speed and are linked together to ensure that the system can achieve ≥ 3 meters per second processing speed output (width * speed * particle size), more than 100 tons/hour

Technology Advantage-Integrated Ray



Split type high - power radiation source

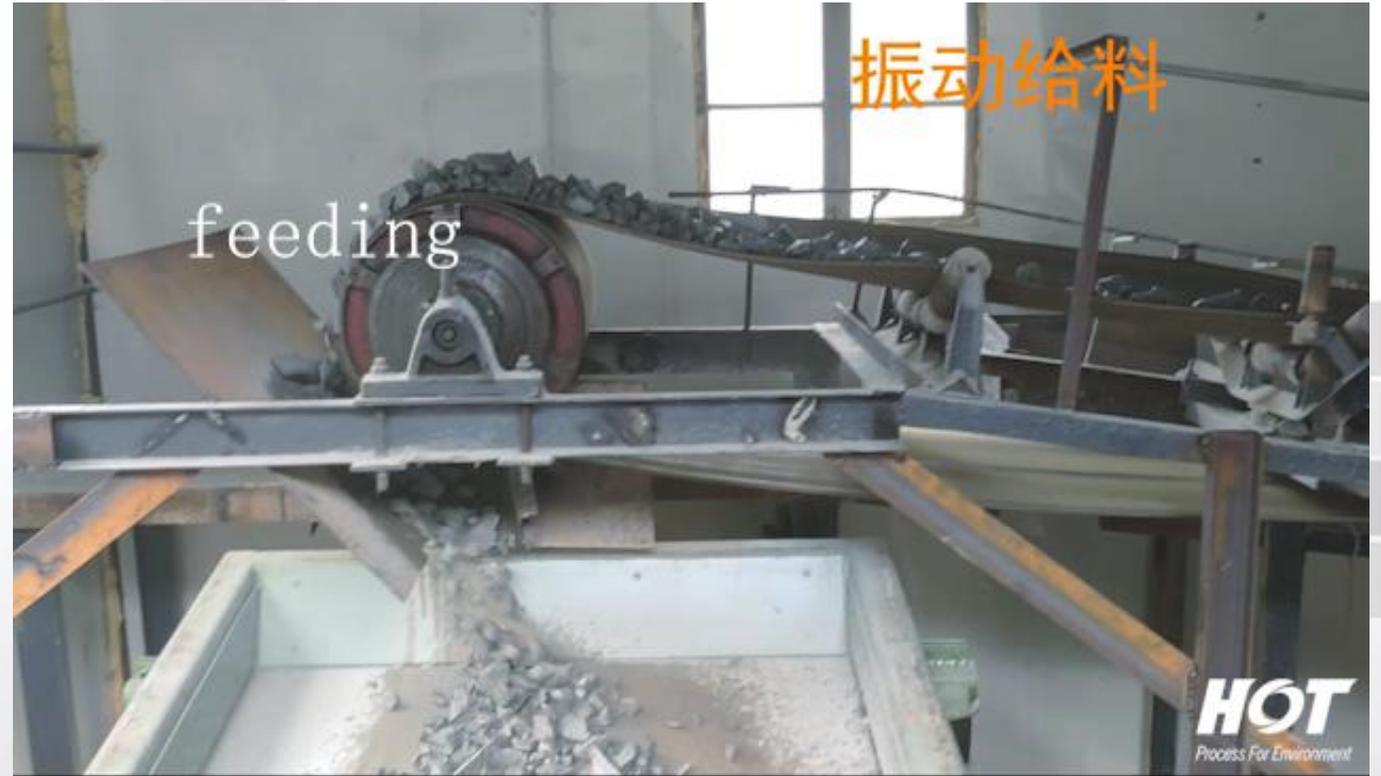


All-in-one small and medium power - ray sources

Content	Miniwatt	Superpower	Explanation
Unit construction	Unibody	Split type	The split structure is complex and the failure rate is high
Radiation protection	Easy	Hard	High-power sources require tons of extra lead for protection
Longevity	Longer	Shorter	The overall loss of the high-power bulb tube is large
Maintenance cost	Lower	Higher	The high pressure and cooling sections of the split require additional regular maintenance
Maintenance cost	Lower	Higher	
Replacement costs	Lower	Higher	The ball tube is a wastage part and the warranty period is relatively short. It has high power and high price, and the replacement cost is high after the warranty is issued
X-ray Emissions	Smaller	Bigger	Difficult to protect. Dangerous leakage
supervision department	County Level	Provincial Level	The greater the power, the stricter the regulation

Techology Advantage-Executive System

- The high pressure air gun has the advantages of quick response and sensitive control. Compared with the traditional mechanical striking board and the new type of manipulator, the high pressure air gun has a significant yield advantage.
- The injection system has two unique 1 m³ air bags, which are more safe and reliable, and qualified in safety supervision and environmental protection inspection.
- The equipment has the function of ore and waste rock measurement, which can replace the ore metering device and can be used for detailed grading statistics.
- The reasonable distance between injection valves can avoid the problem of high grade of waste rock due to the wide spacing between injection valves of similar products, resulting in associated injection or failure to blow, and the concentrate and waste rock are blown out together, resulting in the high grade of waste rock.



Video about Jet Sorting

Technology Advantage-Radiation Safety

The power of the ray source device of the intelligent ore separation machine is 200W, and the actual power is 160W, which is only one fifteenth of the similar products (3000W).

Radiation Comparison Table

State regulations:	Peripheral radiation :
Public personnel < 20mSv/year	Year < 0.5mSv,
Ray practitioner	8 hours a day
	
2-3Sv/year cosmic-ray background	0.05mSv 10,000km flight
	
	10mSv Do a general CT scan

The ray source has simple structure, long service life, low operating cost and high reliability

Ministry of Environmental Protection 《Classification of Ray Devices》

1. The classification principle of the ray device According to the potential harm degree of the ray device to human health and the environment, the ray device is divided into Class I, Class II, and Class III from high to low.

- (1) Class I ray device: short-term exposure during an accident can cause severe radiation damage to the exposed person, and its safety and protection requirements are high;
- (2) Class II ray device: in the event of an accident, it can cause severe radiation damage to the exposed person, and its safety and protection requirements are relatively high;
- (3) Class III ray device: Generally, it will not cause radiation damage to the irradiated persons during accidents, and its safety and protection requirements are relatively simple.

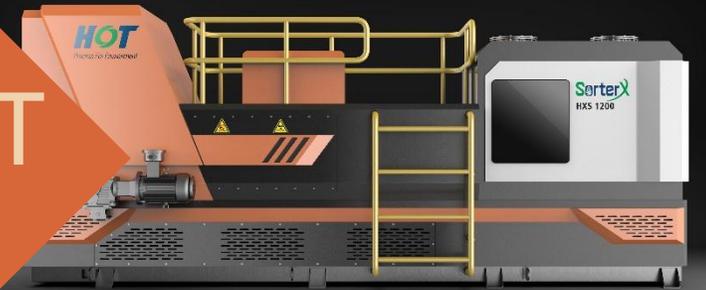


Safer Class III ray device

Applications

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What are the applications of XRT
Intelligent Sorting?



Applications and sensor

INDUSTRIAL MINERALS



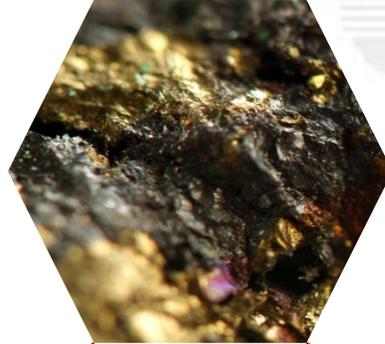
Phosphate- silica removal, lime-stone-silica removal, quartz up-grade, MgQ-silica removal, fluorite pre-conc., talc pre-conc., lithium pre-conc., barite pre-conc.,

DIAMONDS



Kimberlite-waste removal, diamond ROM conc., diamonds final recovery, emeralds ROM conc., rubies ROM conc.

FERROUS METALS



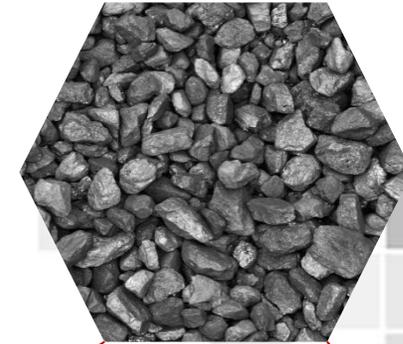
Iron ore grading, hematite pre-conc., manganese pre-conc., chromite pre-conc.

NON-FERROUS METALS



Copper, zinc, gold, nickel, tungsten, silver, platinum group metals

FUEL



Coal waste dumps

SLAG



Stainless steel slag, ferrosilica slag, ferro chrome slag

Application -Coal

Kind of coal

XRT has strong adaptability to coking coal and thermal coal.



Safety Guarantee

Perfect explosion-proof and dust removal design.

Coal(ash)

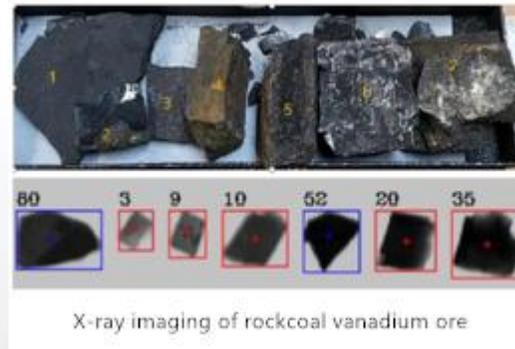
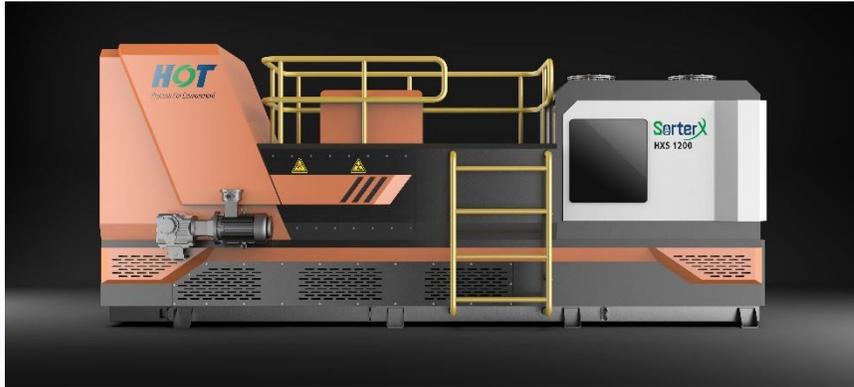
XRT sorter has a good adaptability to raw coal ash. When ash is low and gangue quantity is small, "beating gangue" can be used; when ash is high and gangue quantity is large, "beating coal" can be used in reverse.

Optimization of Waste

Instead of moving sieves or gangue discharge in shallow tanks, a large amount of gangue no longer enters the subsequent washing system, reducing the load on the slime water system.

Application- Non-coal

The HOT-XRT Sorter has been successfully applied to metal mines such as tungsten, tin, antimony, lead-zinc, copper, gold, silver, molybdenum, etc., as well as non-metal mines such as fluorite, phosphorous, ferrosulfur, and coal. It is the only intelligent ore sorting equipment that has mature applications in non-ferrous metal mines, ferrous metal mines, non-metal mines, coal mines and renewable resources.

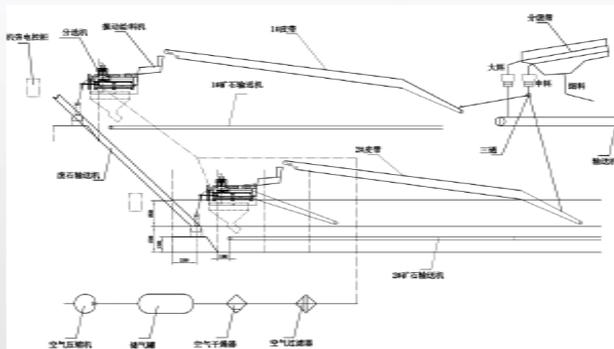


Minerals	Particle size	Product	Productivity	Grade	Recovery
Lead zinc ore	-60+15	concentrate	37.2%	Pb:1.340%;Zn:4.545%	Pb:97.63% ; Zn:98.83%
		tailings	62.8%	Pb:0.019%; Zn:0.032%	Pb:2.37%;Zn:1.17%
		green ore	-	Pb:0.511%; Zn:1.711%	-
Tinstone	-90+15	concentrate	52.8%	Sn:0.6%	Sn:97%
		tailings	47.2%	Sn:0.018%	Sn:3%
		green ore	-	Sn:0.325%	-
Tungsten ore	-60+15	concentrate	34.5%	WO3:0.67%	WO3:96.7%
		tailings	65.5%	WO3:0.016%	WO3:4.3%
		green ore	-	WO3:0.224%	-

About 20 kinds of minerals have been tested, sampled from more than 400 mines, and tested about 2,000 batches.

XRT Intelligent Sorter Application-Cases

Antimony Ore



Equipment installation time: April 2018

Number of installations: 4 sets

Particle size: -100+15mm

Ore properties: sulfide ore, oxidation ore mixed antimony ore. The mine is divided into two mining areas, the south mine and the north mine. The content of oxidized ore in north ore is high.

Output: 90~120 t/h

Scrap rate: 60%~80%, according to the original ore adaptive

Antimony content in waste rock of original selection production line: 0.35%

Antimony content in tailings after XRT separation: <0.1%

Number of alternative workers: 104

Create value: about 20 million CNY / year



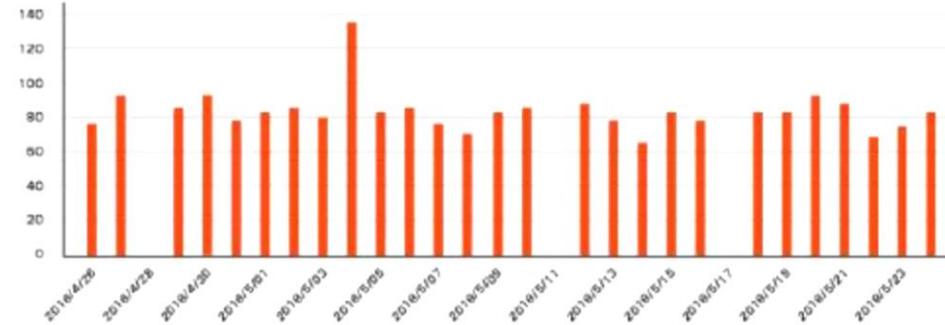
XRT Intelligent Sorter Application-Cases

Antimony Ore-Operation

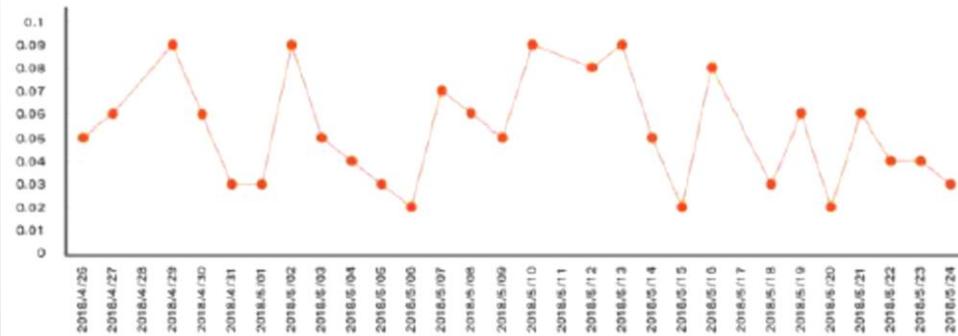


The equipment has been running smoothly for 24 months, replacing 4 manual selection lines and replacing more than 100 manual selection workers.

Average output (t/h)



Tailings grade(%)



XRT Intelligent Sorter Application-Cases

A Tungsten Ore Concentrating Mill



The Selected Ore: calcite - fluorite scheelite, with fine grain size and continuous growth with gangue

Particle Size: +12mm-60mm

Average Grade: 0.18-0.23%

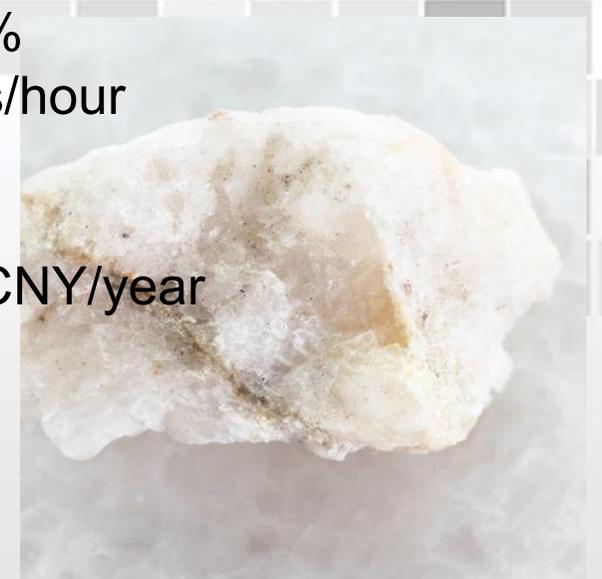
Grade of Waste Rock: 0.03-0.04%

Handling Capacity: about 50 tons/hour

Recovery Rate: 92.5%

Rejection Rate: 45%

Value Creation: about 35 million CNY/year



XRT Intelligent Sorter Application-Cases

A Tin Ore Concentrating Mill



Number of installations: 1set
Ore properties: Cassiterite sulfide ore has fine crystal size and high tin content in pyrite minerals. Tin grade decreased from 1.5% to 0.3% in the early stage of mining.
Particle size: +15mm-90mm
Head grade: 0.3%
Grade of waste rock: 0.05%
Handling capacity: 70tons/hour
Rejection rate: 52%
Recovery rate: > 91%
Value creation: about 1000 million CNY/year



XRT Intelligent Sorter Application-Cases

A Hosphate Ore Concentrating Mill



Number of installations: 1set

Ore properties: Low grade igneous metamorphic rock

Particle size: +15mm-90mm

Average grade: 22%

Phosphate concentrate taste: 27%

Tailings grade: 9%

Processing capacity:> 40 tons / hour

Recovery rate:> 88%

Create value: about 10 million CNY/ year



XRT Intelligent Seorter Application-Cases

Scheelite



A veined scheelite ore			
Name	Tungsten (%)	Productivity (%)	Recovery (%)
Concentrate	0.5	19.33	85.39
Tailings	0.021	80.67	14.61
Crude ore	0.113	-	-

Mineral characteristics: hydrothermal filling quartz vein type scheelite after magmatic period

XRT Intelligent Sorter Application-Case

Gold Sulfide

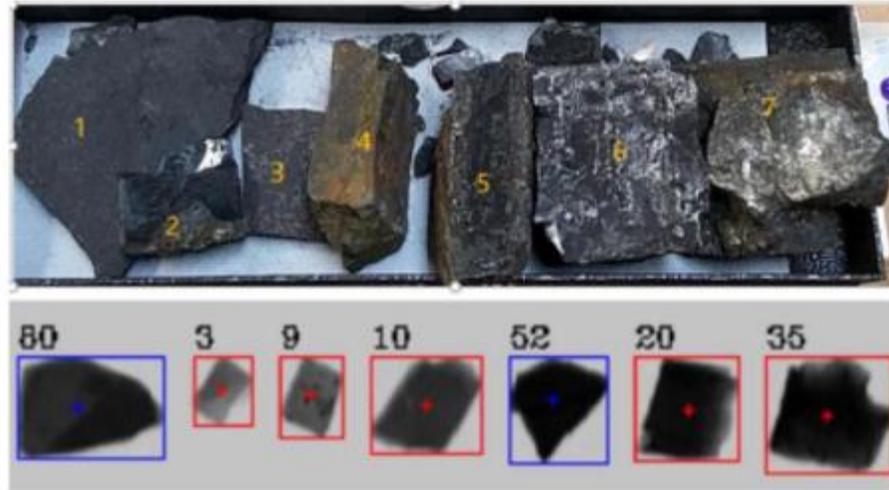


Sulfur gold mineral			
Sample ore	Gold grade(%)	Productivity (%)	Recovery (%)
Concentrate	13.73	40	96.87
Tailings	0.295	60	3.13
Crude ore	5.7	-	-

Mineral characteristics: natural gold and sulfide are densely symbiotic, with a specific gravity between 4.9-5.2, which is obviously different from the associated gangue

XRT Intelligent Sorter Application-Case

Stone Coal Vanadium Ore



X-ray imaging of rockcoal vanadium ore

Deposit characteristics: layered overlapping distribution, carbonaceous SLATE
vanadium grade about 2%, siliceous SLATE vanadium grade about 0.4%, waste rock grade about 0.2%

XRT Intelligent Sorter Application-Case

Hematite



Low grade



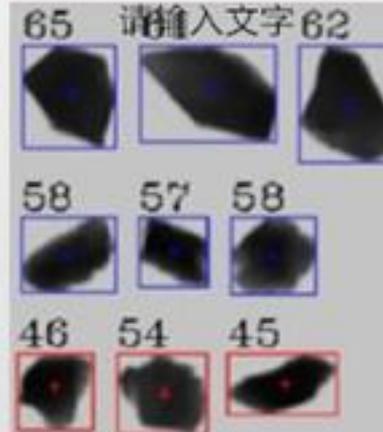
Medium grade



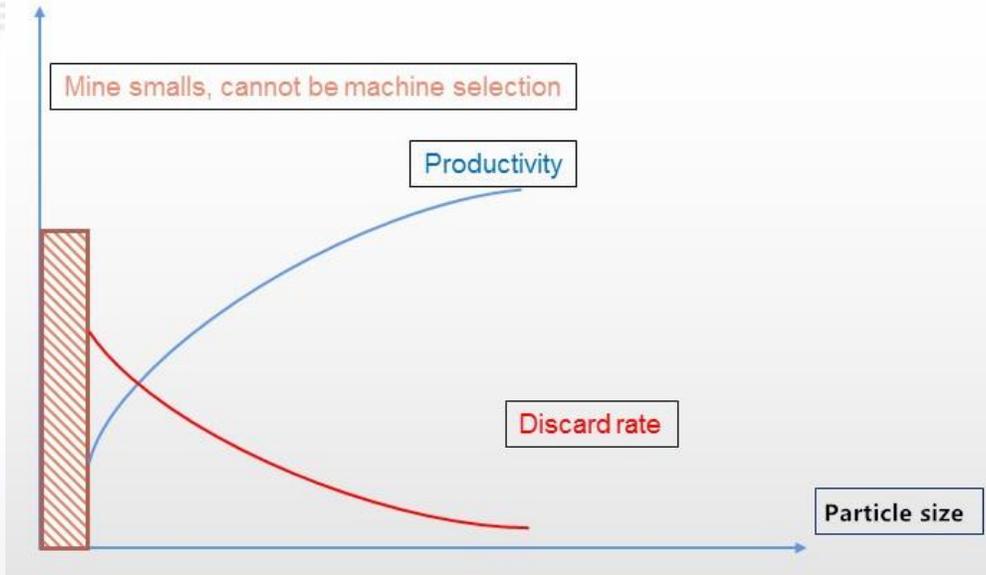
High grade



Simple ore	Crude ore	Low grade	Medium grade	High grade
Weight	134.2Kg	29.1Kg	43.7Kg	61.4Kg
Productivity	100%	21.7%	32.6%	45.7%
Fe2O3	-	26.37%	33.7%	36.16%



XRT Intelligent Seorter Application-Sample test



		Productivity(%)	Content(%)		
			MgO	P2O6	SiO2
Crude ore	Crude ore		6.49	19.03	16.25
The first experiment	concentrate	58.20	2.79	27.85	10.19
	tailings	41.80	11.41	8.96	17.18
The second experiment	concentrate	63.00	3.00	27.17	13.83
	tailings	37.00	11.43	5.83	23.86

Test type:

01 Feasibility

Sample size: 2 ~ 3t
The purpose of the experiment: to seek the best waste disposal rate + job size + output

02 Economic value calculation

Sample size: 50kg ~ 500kg
Experiment purpose: preliminary feasibility experiment

03 Stability

Sample size: > 10t
Experimental purpose: semi-industrial experiment \ industrial experiment \ sales pre-commissioning

Welcome to send us samples for test !

Summary

XRT Intelligent Sorting Technology will be the future development direction of mineral processing

High sorting accuracy

It has a full range of high-precision X-ray detectors with different resolutions and different energy spectrum bands

Wide processing granularity

The range of processing particle size is wide, and the air gun spacing can be flexibly selected according to the requirements of ore processing capacity and ore particle size

Large processing power

Using highly integrated AI algorithm to achieve millisecond-level operation rate, high beneficiation recognition rate and large processing capacity

High level of intelligence

Advanced software control system and algorithm, can realize remote monitoring and online upgrade

Wide range of applications

It is the only one in China that can deal with metals, nonmetals and coal mines

/Contact US/

Address:

Chengdu Office: Room 1104, Building A, AVIC
International Plaza, No. 777 Yizhou Avenue,
High-Tech Zone, Chengdu

Tel: +86-028-8331-1885

Web:

www.hotmining.cn (中文)

www.hotminingepc.com (英文)

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Thanks!

