SorterX

HOT
Process For Environment

Sensor-based & Water-free

XRT Intelligent Ore Sorter

- X-ray Transmission Technology
- Highest precision
- Largest range of particle
- Available for most of raw ores

BEIJING HOT MINING TECH CO LTD

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HOT
Process For Environment

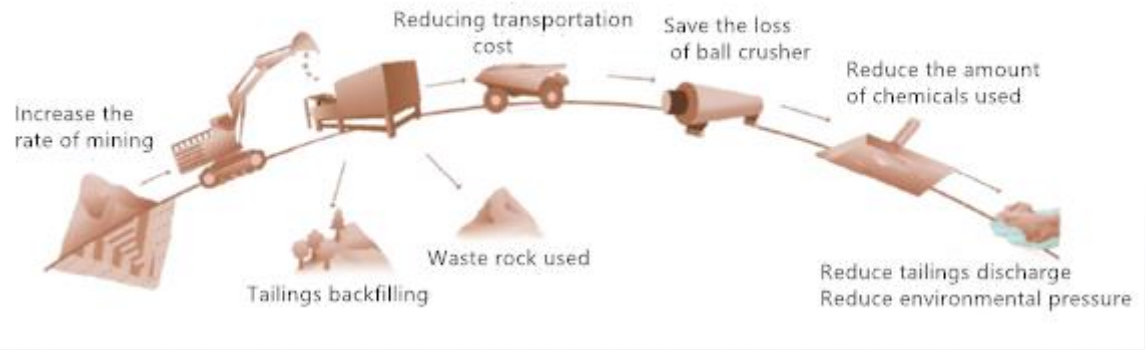
XRT

PART 1

Background

Why we study XRT?

XRT Intelligent Sorting Technology-Value in Mining Industry



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.

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.

HOT
Process For Environment

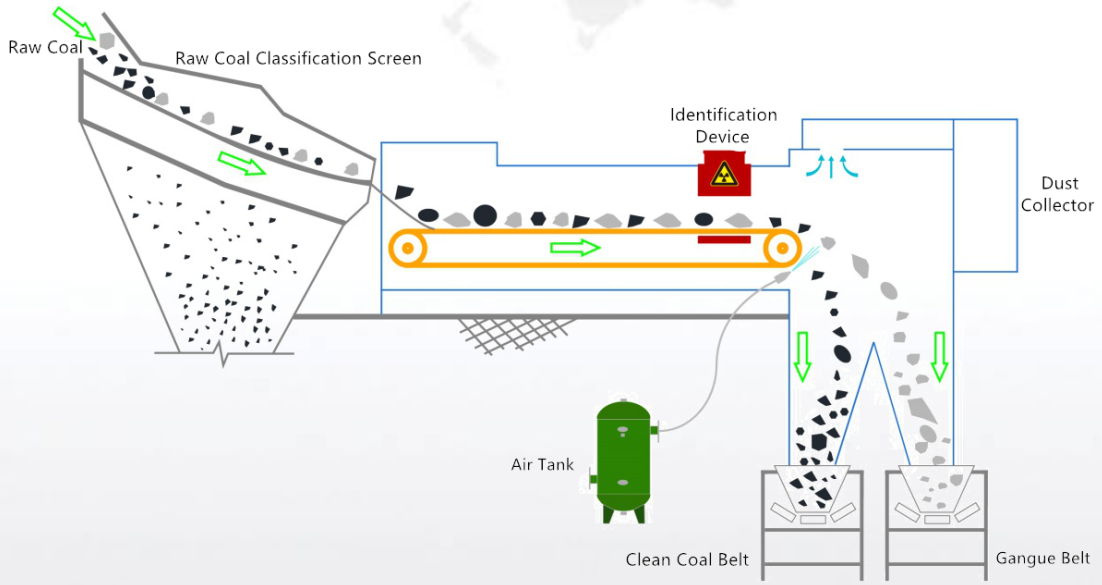
Introduction

PART 2

What is the XRT?

SorterX

XRT Intelligent Sorting - Working Principle

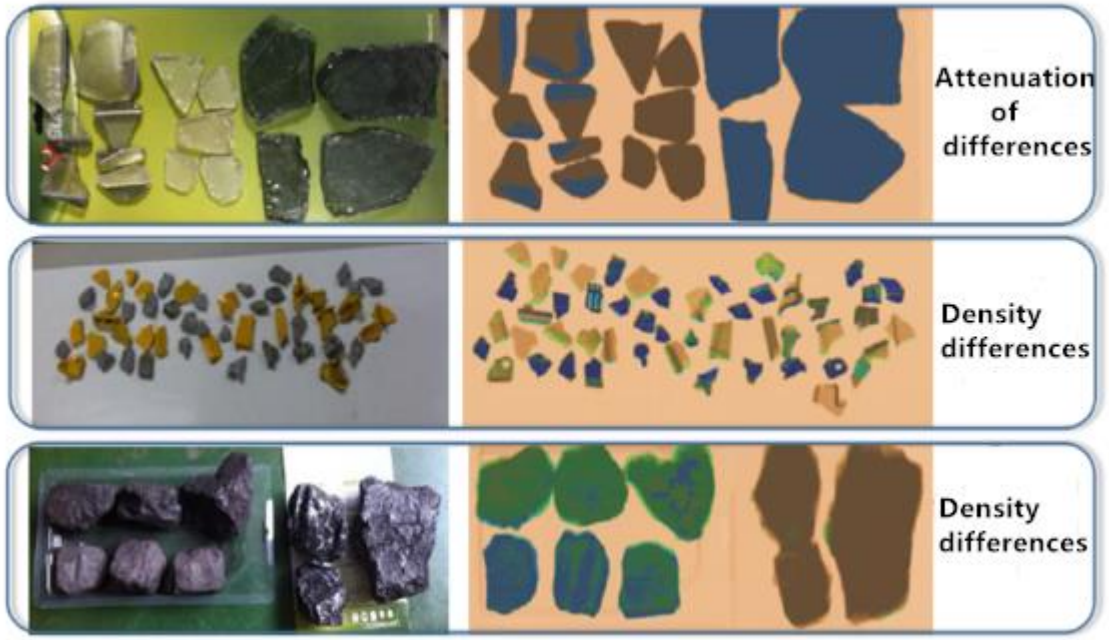


Working Principle

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.

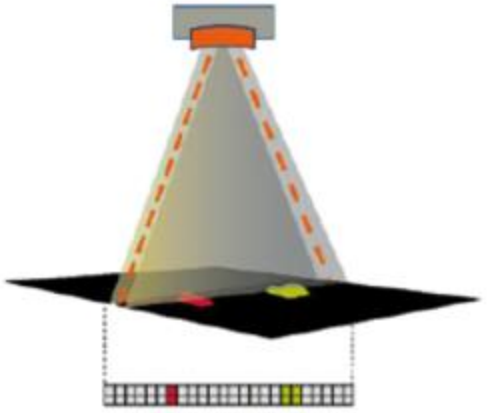
XRT Intelligent Sorting-Identifying Principle

		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	10^{-10}	XRT (x-ray transmission)	Atomic density	Common/precious metals, coal, diamond
Ultraviolet (LV)	10^{-9} 10^{-8} 10^{-7} 10^{-6} 10^{-5} 10^{-4} 10^{-3} 10^{-2} 10^{-1}	XRT (x-ray transmission)	X-ray visible fluorescence	Diamond
Visible light (VIS)		COLOR(CCD colour camera)	Reflection, Brightness, Transparency	Common/precious metals,industrial mineral, diamond
Near-infrared (NIR)		PM (Spectropho-tometry)	Monochrome reflection / absorption	Common metral, diamond
Infrared ray (IR)		NIR (Infrared spectrometry)	Reflection, Absorption	Common metral, industrial mineral,
Microwave	10^{-1} 10^{-2} 10^{-3} 10^{-4}	IR (off line cam)	Thermal conductivity,heat dissipation	Common metral, industrial mineral
Electromagnetic wave		MW (Heating combined with infrared analysis)	Sulfide and metals heat up faster than other minerals	Common/precious metrials
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

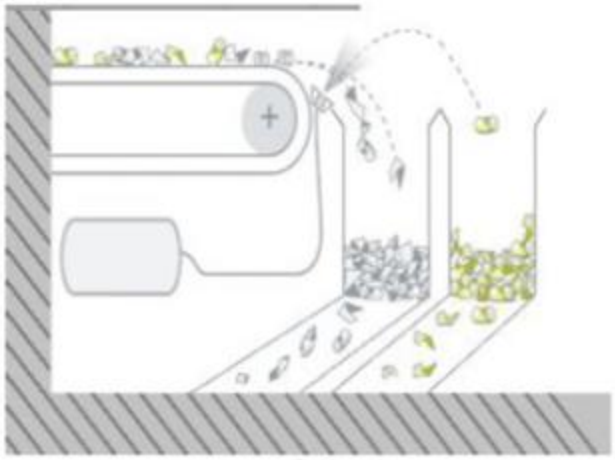


XRT High precision sensor system

- 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

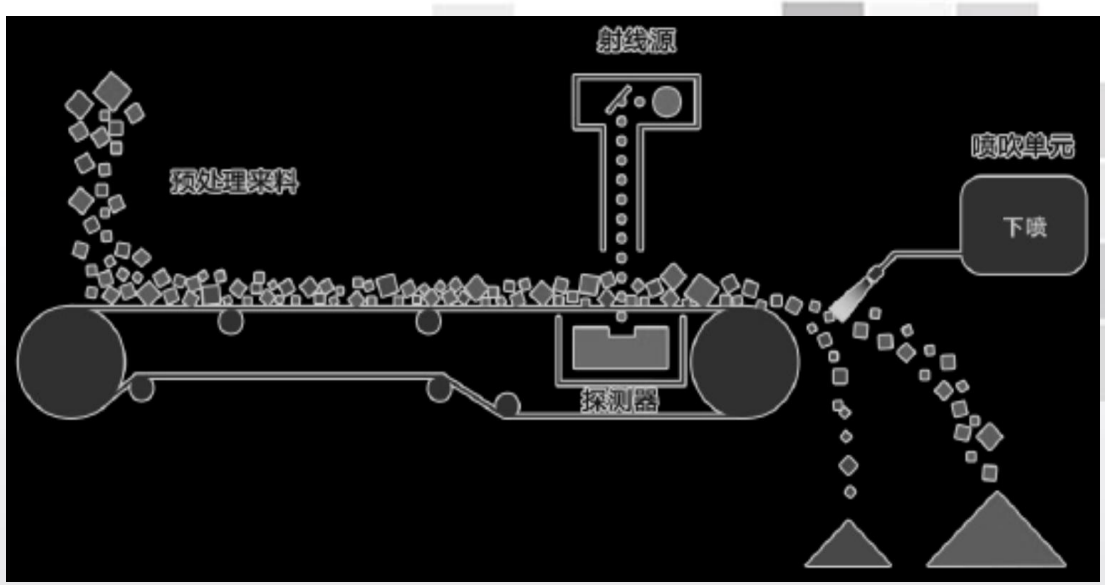
- Self-developed injection control
- Sub-millisecond response time

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	

XRT Intelligent Sorting-Device Parameters（Coal Mine）

300-50mmTXS Intelligent Sorter Selection Table

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 Power(t/h)	80	100	120	140	160	180	220	260	300
Separaton Size(mm)	300~50	300~50	300~50	300~50	300~50	300~50	300~50	300~50	300~50
Supporting Factory 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%.									

100-25mmTXS Intelligent Sorter Selection Table

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 Power(t/h)	48	60	72	84	96	108	132	156	180
Separaton 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?

Techology Advantage-Detetor 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

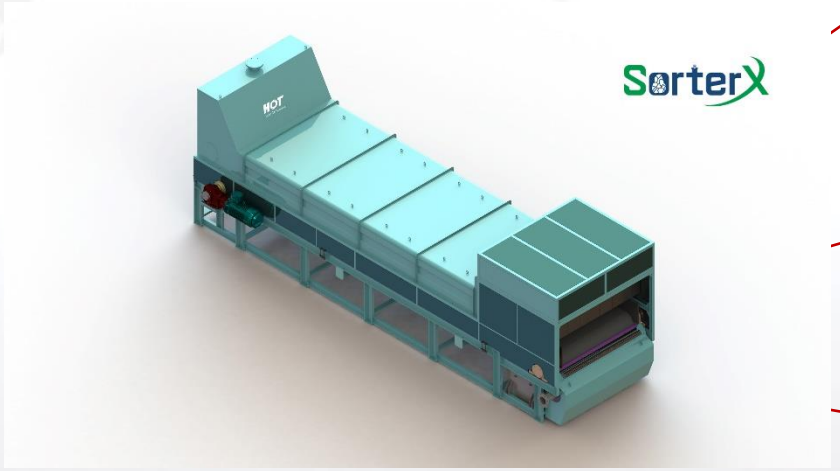
Self-developed detectors can be specially customized and deeply optimized.
It has a full range of X-ray detectors with different resolutions and different energy spectrum bands.
Increase recognition accuracy and improve sorting accuracy

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.

The importance of detectors and algorithms can be simply analogized to a good camera, which can take good pictures in low light; good X-ray detectors and algorithms can also get good images under weak X-rays.

Techology Advantage-Hight Speed and Production



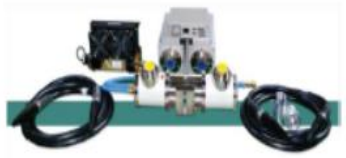
Detector acquisition speed:
Self-designed ultra-high speed
ray detector system with
sampling frequency up to 12KHz
is the fastest in the world

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

Techology Advantage-Integrated Ray



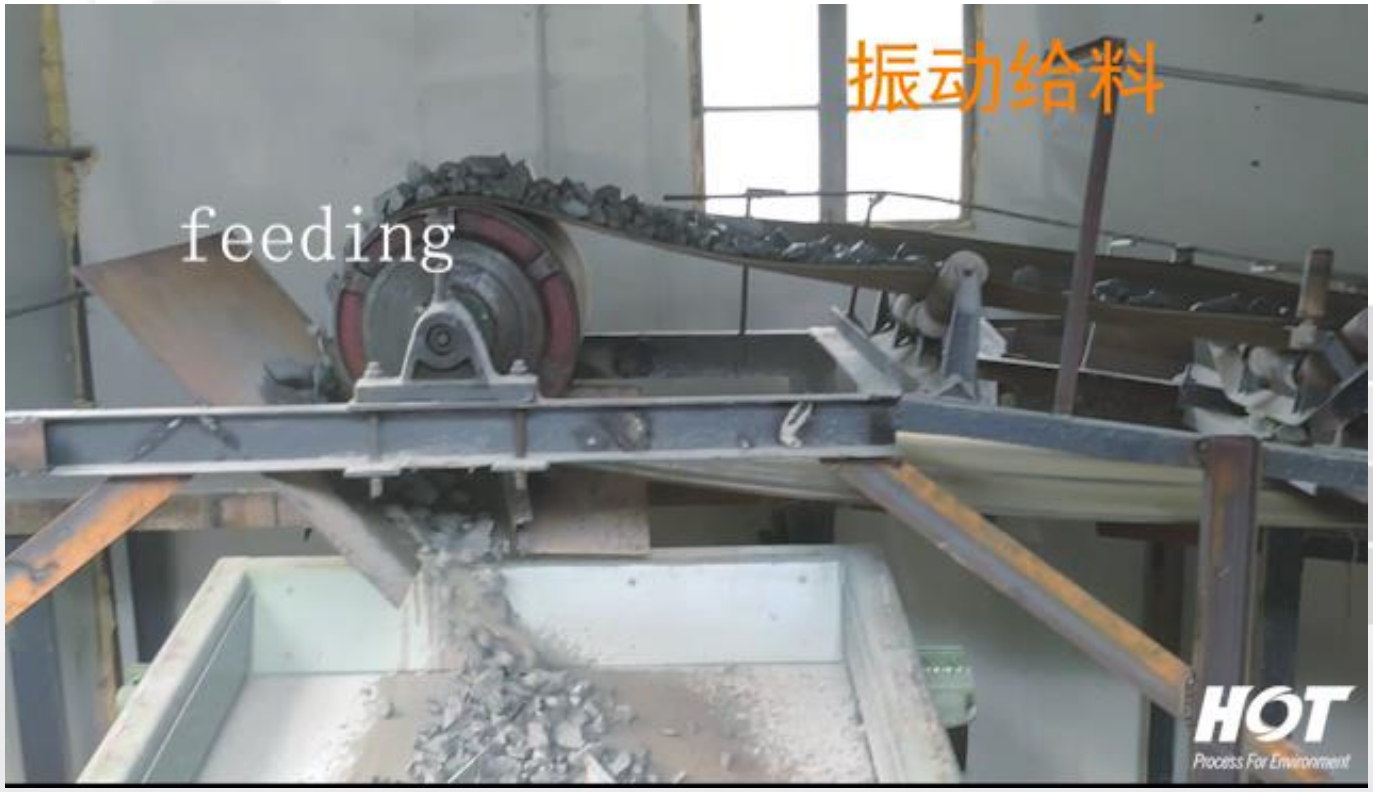
Split type high - power radiation source

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 m^3 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

Techology Advantage-Radiation Safety

The power of the ray source device of the intelligent ore sseparation 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;（C) 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.

Use safer Class III ray dev

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Applications

PART 4

What are the applications of XRT Intelligent Sorting?

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Applications and sensor

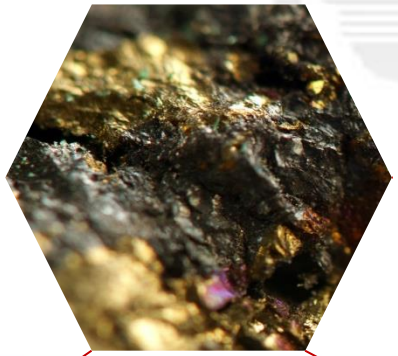
INDUSTRIAL MINERALS

Phosphate- silia 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

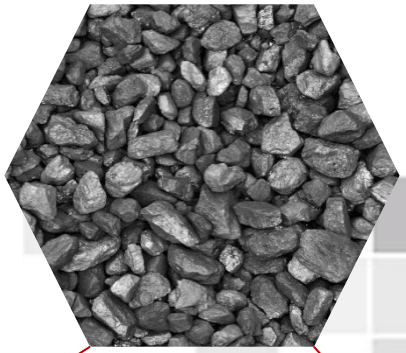


Iron ore grading, hematite pre-conc., manganese pre-conc., chromite pre-conc.

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.

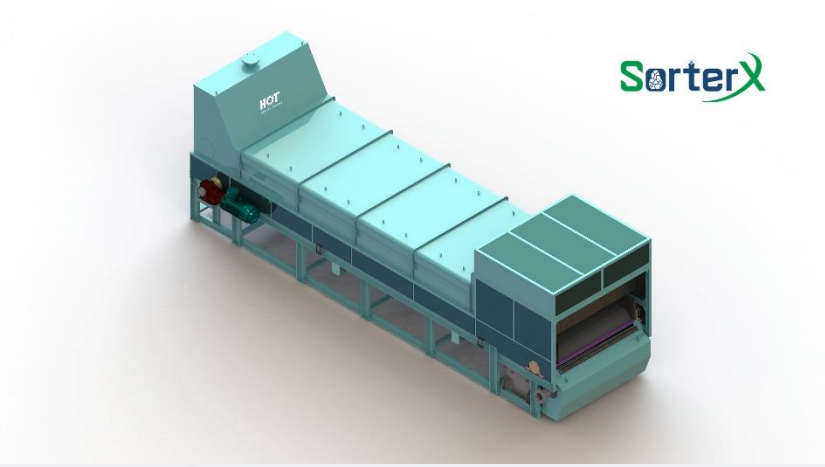
Coal(ash)

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.

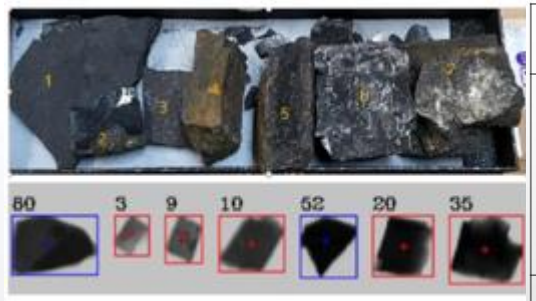
Optimization of Waste

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 renewableresources.



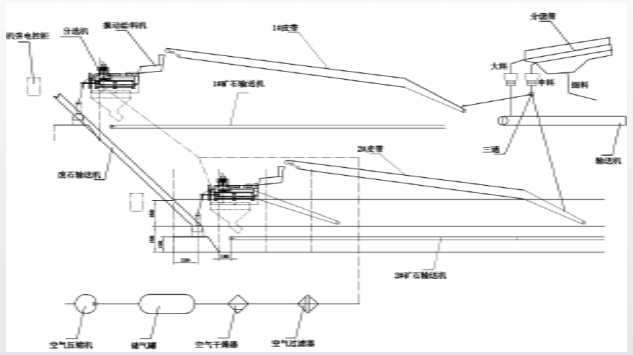
X-ray imaging of rockcoal vanadium ore

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%	Sn3%
		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%	-

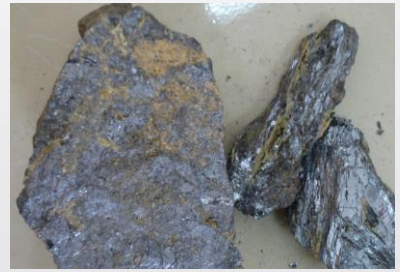
About 20 kinds of minerals have been tested, sampled from more than 400 mines, and tested about 2,000 batches.

XRT Intelligent Sorter Application-Cases

Antimony Ore

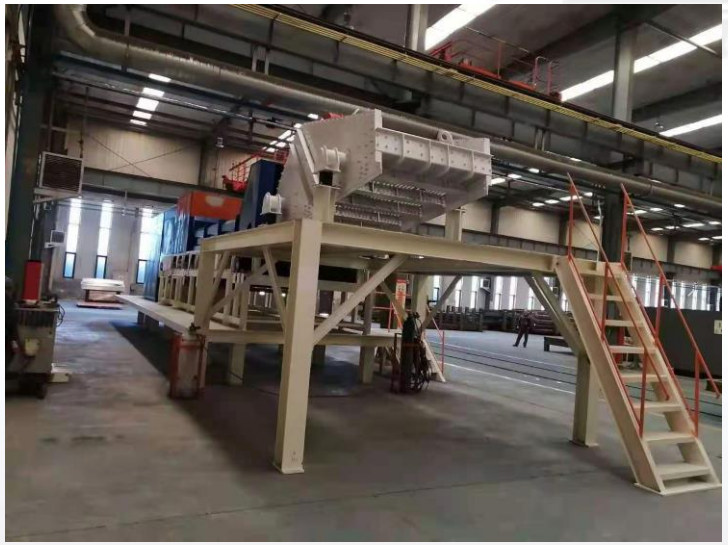


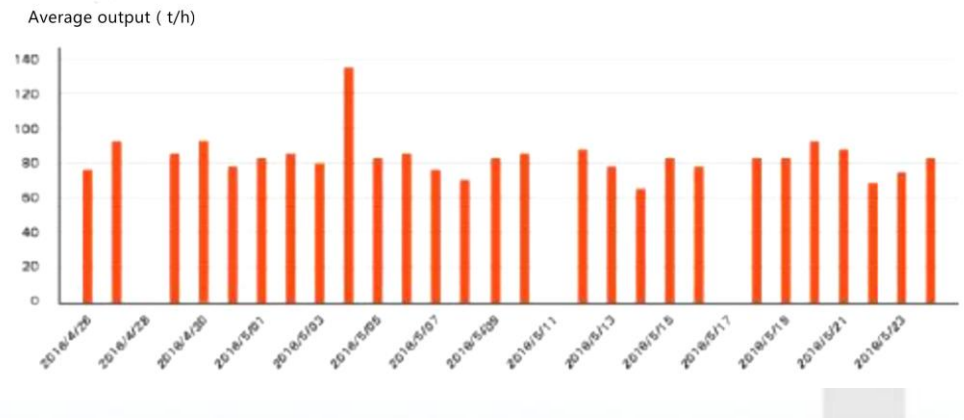
Equipment installation time： April 2018
Number of installations： 4 sets
Particle size： -100+15mm
Ore properties: sulfide ore, oxidation ore mixed antimony ore. The mine is divided into two mining areas, the south mine and the north mine. The content of oxidized ore in north ore is high.
Output: 90~120 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

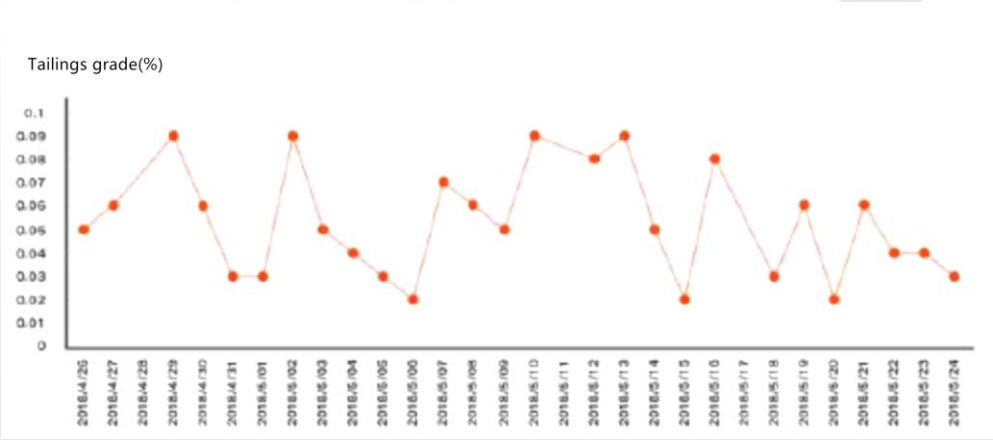


XRT Intelligent Sorter Application-Cases

Antimony Ore-Operation





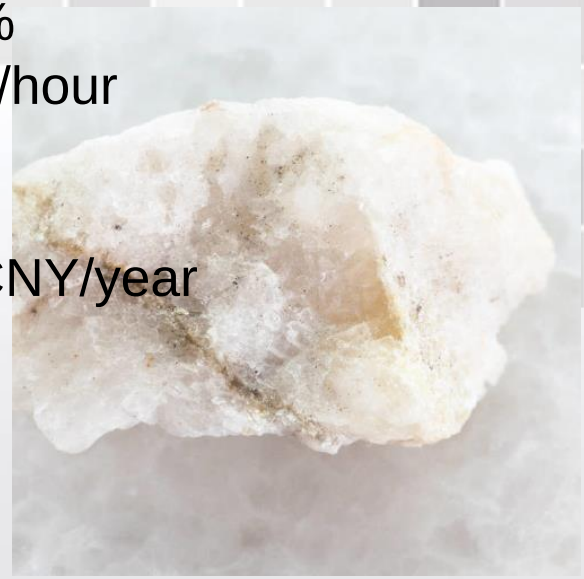


The equipment has been running smoothly for 24 months, replacing 4 manual selection lines and replacing more than 100 manual selection workers.

XRT Intelligent Sorter Application-Cases

A Tungsten Ore Concentrating Mill

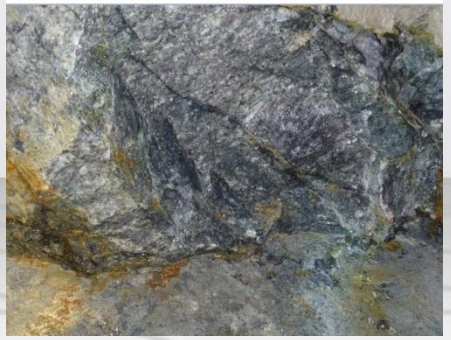
The Selected Ore: calcite - fluorite scheelite, with fine grain size and continuous growth with gangue
Particle Size： +12mm-60mm
Average Grade: 0.18-0.23%
Grade of Waste Rock: 0.03-0.04%
Handling Capacity: about 50 tons/hour
Recovery Rate: 92.5%
Rejection Rate: 45%
Value Creation: about 35 million CNY/year



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： about1000 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

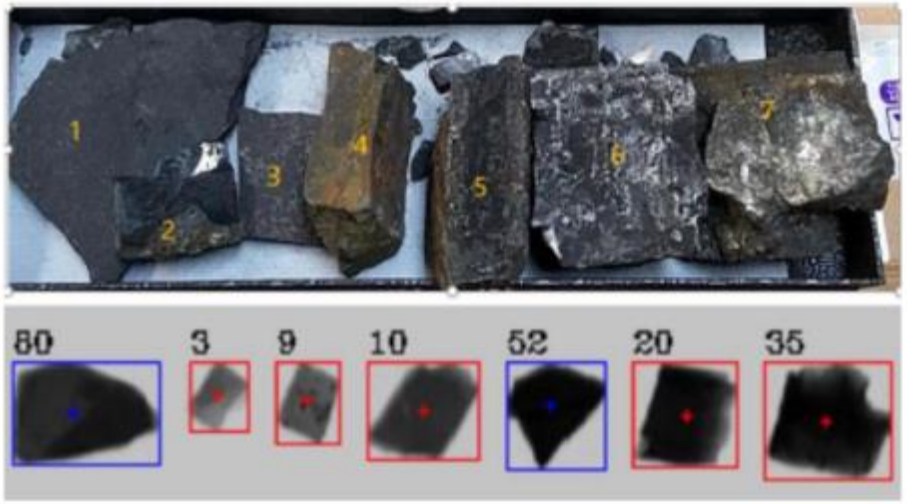
Gold Sulfide

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

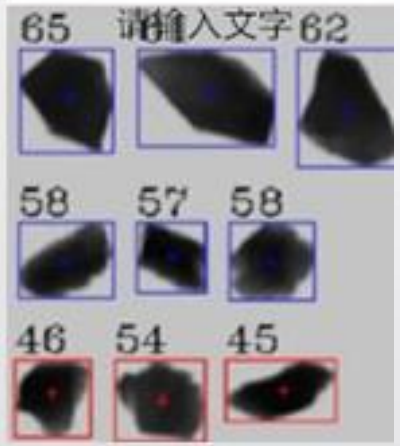
Hematite

Low grade

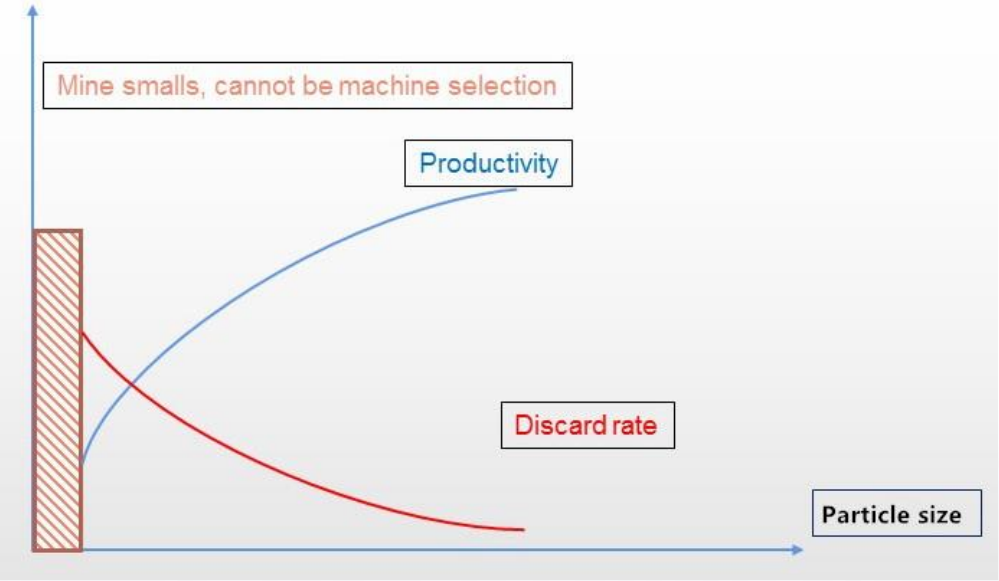
Medium grade

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/

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HOT Process For Environment SorterX

Thanks !