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HOW TO EVALUATE AND COMPARE DIFFERENT MODELS & MAKES OF X-RAY DIAMOND RECOVERY MACHINES.

The following guidelines are given by Peter Wolf of FLOW SORT (PTY) LTD.

1. OPERATING CRITERIA FOR AN X-RAY DIAMOND RECOVERY MACHINE

a. Be sure that YOU know what you expect the x-ray sorters to sort! DON'T ask the manufacturer of such machines! The prime questions that YOU have to ask and answer yourself are:

b. What size fraction of diamond concentrate do you wish to sort? What is the bottom size? What is the top size?

c. How many tons of diamond-differous material needs to be sorted per day?

d. How many hours per day do you intend to operate your x-ray diamond recovery machines?

Note that most x-ray diamond recovery machines can quite happily operate 24 hours per day! Don't forget to allow a few hours per week for maintenance.

2. CREDENTIALS OF THE MANUFACTURER

a. When comparing x-ray diamond recovery machine manufacturers consider the following:

b. FLOW SORT is synonymous with Peter Wolf (spell WOLF backwards...yes, that's where FLOW got its name from!)

c. FLOW is now operating for over 30 years

d. Wolf has designed (over 50 different models) and built X-ray diamond recovery machines (over 600 units) since 1970. In the past 10 years alone FLOW SORT has manufactured over 200 of its new generation x-ray diamond recovery machines!

e. We welcome any new customers to contact current FLOW SORT x-ray diamond recovery machine users for references.

f. FLOW SORT does not hide behind a big 'confidentiality screen'. Whatever we do, whatever we promise, whatever we specify is available to all our customers without any restrictions.

g. Wolf invented the first truly WET-FEED diamond recovery machine in 1978.

h. Wolf has filed no fewer than 18 patents relating to electronic sorting, one of them is the revolutionary FLOW SORT MECHANICAL EJECTOR!

i. Wolf has also written several papers and held numerous lectures on Electronic Sorting.

3. **PURCHASE PRICE** When you compare the purchase price of any diamond recovery machine with the cost of a FLOW SORT machine consider the following:

   a. When you buy a FLOW SORT machine you do not need any other "auxiliary" equipment.

   b. Check what "EXTRAS" you need to purchase to make our competitors sorters usable:

      i. Water chillers and water circulation pumps for cooling of X-ray tubes?

      ii. A compressor (oil-free) ?

      iii. A compressed air conditioning plant (oil absorber, air-dryer, micro-filter etc.) ?

      iv. Dust extraction equipment?

      v. Drying equipment for sorters that can only sort dry or damp material ?

   c. Add all these extras to the purchase price of our competitors' sorter price and then compare it with the cost of a FLOW SORT machine!

   d. Compare the materials used in the construction of our competitors' products with materials used in FLOW SORT machines:

      i. FLOW SORT machines are constructed of "solid" 316 stainless steel components. Even if used in the harshest marine environment FLOW SORT machines will last many decades!

      ii. When it comes to selecting components and materials, we don't compromise at FLOW SORT; the best is just good enough! Agreed that it is the customer that has to pay for it not FLOW but it is a policy that has paid off! After all, if you pay for a Porsche, you drive a Porsche! If you buy a Volkswagen you pay a lot less but you drive a Volkswagen. If you buy a Volkswagen for the price of a Porsche…you have made a bad buy!

e. It is of course also absolutely essential that you relate the capital cost of any sorter to its sorting capacity and to its operating performance as well as its operating cost! This is the only way to compare 'apples with apples'! (A Porsche you only service every 20 000 km and then you only pay for tyres!)

f. Check the resale value of the sorter you are being offered! FLOW SORT'S machine resale value remains high, check the market!

g. Here is another very important factor to consider when buying x-ray diamond recovery machines: A mine's requirements for x-ray diamond recovery equipment does change. Through-put figures change, size distribution does change, size fractions to be sorted might change and so forth! Check how flexible a product you buy! FLOW SORT diamond recovery machines are totally flexible. A single stage sorter can be joined with another single stage sorter to form a twin-stage sorter. A twin stage sorter can be split into two single stage sorters. A XR 2/19 DW (a fine material sorter) can be changed into a XR 15/35DW (a coarse material sorter) and visa versa. A standard production (bulk) sorter can be converted into a re-concentration machine and visa versa. If you want to change from sorting dry material to wet material (or visa versa) no sorter modifications are required. Check if you find this flexibility with any other make of x-ray diamond recovery machine!?

4. OPERATING COST

a. Here it is important to add the operating cost of our competitors' sorter 'auxiliary' equipment to the operating cost of the sorter itself. Remember that FLOW SORT sorters do not require any 'auxiliary' components and therefore there are no hidden operating costs!

b. Take note that drying the feed material to a sorter for instance, is a major operating expense!

c. An instrument quality compressed air supply is also a rather costly affair!

d. X-ray tubes, very expensive components, are used in all x-ray fluorescence based diamond recovery machines. All these x-ray tubes have a limited operating life. The more x-rays an x-ray tube must produce the shorter is the life span. Note that FLOW SORT machines operate their x-ray tubes at 10 milli Amp and these sorters achieve x-ray tube live times in excess of 35 000 (thirty five thousand) hours! Compare this with other make of sorter. Some of them use twice as much x-ray power! The replacement cost of a sorters x-ray tube is a most important operating cost factor!

e. Once again operating costs must be related to throughput.
(Calculate operating cost per ton of material sorted).

5. **EASE OF SORTER OPERATION AND MAINTENANCE** (Check how our competitors compare on the following:

a. FLOW SORT machines feature a patented open-frame modular construction which makes maintenance operations quick and very simple.

b. FLOW SORT also offers an around the clock exchange module service which minimizes down-time in case of breakdown.

c. It follows from the two above mentioned features that no highly qualified personnel are required to operate or maintain FLOW SORT machines.

d. FLOW SORT provides back-up for all its products no matter which model of sorter, no matter how long a sorter has been in service! We keep spares in stock for products that we manufactured 30 years ago! Once you have bought a FLOW SORT product you are guaranteed our support for the life time of our product? To put some perspective to 'life time'…some of the Wolf designed and manufactured x-ray sorters are operating since 1972!

e. All of FLOW SORT diamond recovery machines of the popular XR and TSXR series can be converted from one model to the other! (Refer to para 3 g.)

f. FLOW SORT machines come with a standard remote monitoring / diagnostic interface!

6. THROUGHPUT CLAIMS

a. Don't fall into the trap and pay attention to feed-rate figures quoted such as "UP TO…" some impressive tonnage! Insist on a written throughput guarantee for your specific feed material!

b. The capacity of any x-ray diamond recovery machine is limited to a single layer (single file) of material flow. In practical terms that means:

   i. that the wider the material stream is the higher the throughput.

   ii. the faster the material stream moves the higher the throughput.

c. At FLOW SORT we do not believe in manufacturing high capacity machines (sorters with a wide material stream). We rather supply several medium capacity sorters. This approach has the obvious advantage, that should a problem occur (or a sorter needs to be taken off-line for maintenance) only a small amount of the sorter plant production is affected!

d. The speed of the material passing through a sorter is limited by physical factors the explanation of which does not fit the frame work of this write-up. With 30 years of experience in designing x-ray diamond recovery machines we have learned to optimize material speed.

e. When comparing throughput specifications of different x-ray sorters it is important to:

   i. Consider the average specific gravity of the material to be sorted. (Half the s.g. means half the throughput).

ii. Consider the typical particle shape of the material to be sorted. If the material consists mainly of 'flat' particles the sorter throughput will be significantly lower!

iii. Consider the average particle size within a given material size fraction. A +2mm -5mm size fraction will typically only yield an average particle diameter of 2.9mm and not the commonly used arithmetic mean of 3.9mm!

iv. FLOW SORT always quotes very conservative throughput figures. We have never been faced with the (typical) problem of supplying a sorter that could not achieve our specified throughput in the field! On the contrary, we find that our customers process substantially more material through our sorter then the sorters design capacity without any loss in diamond recovery efficiency. (Even double the throughput!).

7. DIAMOND RECOVERY EFFICIENCY

a. This is, besides claiming unobtainable throughputs, the second point that is commonly used by x-ray diamond recovery machine manufactures to claim superiority of their product.

b. There is however a very simple principle that must be applied. If a diamond fluoresces more than the majority of other particles in a given feed material than it is possible to recover this particular diamond. If a diamond fluoresces less than the majority of other particles in a given feed material then it is not possible to recover this particular diamond.

c. In some cases it is possible to increase the ratio between fluorescent diamonds and fluorescent 'non-diamond particles by using optical filters. FLOW SORT uses a narrow band-pass filter (K45) for this purpose.

d. Please take note that diamond recovery efficiency is NOT affected by wet feed material if the sorter is properly designed and built!

e. FLOW SORT x-ray diamond recovery machines typically achieve diamond recovery figures above 99.8 % (by number of diamonds) with wet material when operated and maintained to FLOW SORT specifications. Diamond recovery figures based on diamond value often exceed 99.9% Please check manufactures claims of diamond recovery with customers that are using the same sorter model! FLOW SORT invites any potential new customer to contact any of its clients for reference on the performance of some 400 (four hundred) FLOW SORT diamond recovery currently operating world wide. FLOW SORT updates its ever growing client list monthly. This list is available to all potential customers!

f. Do not get fooled by misleading claims of **tracer recovery** efficiency! Luminescent tracers recommended and used by most x-ray sorter manufacturers are NOT suitable for testing or evaluating FLOW SORT

machines. Insist that any comparative test must be done with FLOW SORT approved tracers!

8. WET FEED VERSUS DRY FEED

a. There is little to say. It is obvious that it is a huge advantage if an x-ray diamond recovery machine can sort the material as it comes from either a pan or a dense media plant without having to de-water and dry the material first!

b. It is simply a matter to design and build a machine that is able to sort wet feed material. FLOW SORT has mastered (and patented) this process. Our success is confirmed with our sales record. Even customers who have their own group-internal x-ray diamond recovery machine manufacturing facility are buying FLOW SORT products!

9. MECHANICAL EJECTOR VERSUS COMPRESSED AIR EJECTOR

a. Air ejectors have been used in x-ray diamond recovery machines for the past 30 years.

   i. In dry material sorters air ejectors generate a lot of dust in an area of the sorter were dust affects the sensitive optical diamond fluorescent detection system. This necessitates the use of dust extraction and automated optic cleaning systems.

   ii. In a wet material sorter "dust" is replaced with atomized water and mud…a nightmare!

   iii. It is further worth mentioning that the interaction between the blasts of compressed air released by an air ejector are governed by highly complex aerodynamic effects which can lead to diamond losses under certain circumstances. (Two fluorescent particles following each other at specific distances, the shape of the particle to be ejected, etc.)

b. Mechanical Ejector? It becomes obvious from the above that a simple gate that forces any diamond into the concentrate bin by momentarily closing the tailings outlet of the sorter is the answer. No dust, no water or mud splashing around, no worries about particle shape, no worries about diamonds following each other at a critical distance, no effects of aerodynamics to worry about! Also no need for air compressors, air dryers, filters, etc.

c. So why are not all x-ray diamond recovery machines fitted with mechanical ejection gates? Well, it was not easy to design and manufacture a mechanical gate that can open and close more than 20 (twenty) times per second. FLOW SORT succeeded with a new (patented) design some 10 years ago - by now proven in over 200 FLOW SORT machines. Our mechanical ejector system is one of the key factors contributing to the success of our XR and TSXR diamond recovery machines! And finally, FLOW SORT mechanical ejectors do not generate more yield per ejection then a comparable air ejector!

Summary of sorter selection / comparison criteria:

1. When buying an x-ray diamond recovery machine make sure that you get **advice from a leading expert** in this highly specialized field. Contact FLOW SORT'S Peter Wolf!

2. Carefully check the track record of the company from which you consider buying your sorter. **How many sorters, of the SAME MODEL that you are offered to purchase,** are currently operating in the field? What service back-up etc can you expect? Check references! **FLOW SORT has been in business for over 30 years!** There are currently **over 430 FLOW SORT machines** in the field! Check our credentials with any of our customers.

3. When comparing purchase price of different makes of x-ray diamond recovery machines **add the cost for all 'auxiliary' equipment** that you need to operate this sorter to the actual sorter cost. (Compressor, air dryer, x-ray cooling water chiller, feed material dryer, etc.) For a **FLOW SORT machine you need NO 'auxiliary' equipment** whatsoever, so there is NO extra cost involved!

4. When comparing operating costs of different makes of x-ray diamond recovery machines make sure that you **add in the operating cost of ALL 'extra' equipment** that you need to operate with your sorter! With a FLOW SORT machine there are **NO EXTRAS!**

5. How easy is it to operate and maintain the sorter you consider buying? FLOW SORT machines are of modular construction, designed for rough handling, simple operating and easy maintenance. **Don't service or repair on site**; utilize FLOW'S exchange unit service!

6. Make sure that you get a written through-put guarantee, without any qualifications! **FLOW SORT does guarantee the quoted (specified) throughput of its sorters** without any "IF's" and "BUT's"!

7. Make sure that you **get YOUR diamonds and YOUR feed material expertly tested** before you purchase any x-ray based diamond recovery machine. FLOW SORT offers an analysis service to all its potential customers at no cost!

8. Recovery of diamonds from wet feed material is most definitely preferable to recovery of diamond from dry feed material for the simple reason that feed preparation processes prior to x-ray diamond recovery are wet processes! **FLOW SORT machines are designed to sort wet material, even i sea-water is acceptable**. FLOW SORT machines obviously can also sort dry feed material. It is however not surprising that so far no one has ever taken up this option!

9. **FLOW SORT'S mechanical ejector has many advantages** as compared to the traditional air ejectors. For a wet feed x-ray diamond recovery machine it is a must! Further note that FLOW SORT mechanical ejectors do not generate more yield then their pneumatic counterparts.

Peter Wolf