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**WHAT YOU SHOULD KNOW
ABOUT
X-RAY LUMINESCENCE TRACERS
BEFORE USING THEM
ON
FLOW SORT
X-RAY DIAMOND RECOVERY
MACHINES**

1. BACKGROUND

- a. Flow Sort diamond recovery machines employ a different x-ray – optic geometry as compared to other x-ray diamond recovery machine makes and models.
- b. The Flow Sort x-ray / optics geometry is such that optical luminescence detection of a particle is taking place on **side opposite** to the side irradiated with x-rays. This Flow Sort design concept has got several advantages over traditionally employed geometry whereby a particles luminescence is detected at the **same side** as irradiated by x-rays.
- c. One of the major advantages of the Flow Sort concept is the ability to distinguish between surface luminescence of a particle and luminescence of a diamond.
 - i. Surface luminescence occurs with many minerals typically present in diamond differous material. It is obviously undesirable to collect such particles together with luminescent diamonds
 - ii. Diamonds show x-ray induced luminescence being generated throughout their body. Due to a diamond's translucency to x-ray

induced luminescence such luminescence can be detected at any point of their surface.

- d. Note that this feature automatically also means that a Flow Sort Diamond Recovery machine does differentiate between luminescent tracers that exhibit only surface luminescence and tracers that, like diamonds, produce luminescence throughout their entire volume!

2. DIFFERENT TYPES OF TRACERS

- a. To effectively test and / or calibrate a Flow Sort diamond recovery machine by means of using x-ray luminescent tracers it is of utmost importance that the correct tracers are used.

Only tracers that accurately simulate x-ray luminescence properties of a diamond are suitable for Flow Sort x-ray diamond recovery machines.

- b. For clarification these properties are:
 - i. X-ray attenuation properties of the tracer material
 - ii. X-ray absorption properties of the tracer material
 - iii. Translucency to the x-ray induced luminescence of the tracer material
 - iv. Energy spectrum of the x-ray induced luminescence of the tracer
- c. Note that the specific gravity of tracers suitable for Flow Sort X-ray Diamond Recovery machine is NOT important as long as it is above 1.0!
- d. **Be aware of our (Flow Sort's) competitors who love to deliberately use X-ray luminescent tracers which DO NOT possess x-ray luminescence properties of a diamond (and hence are not suitable for use with Flow Sort machines) to discredit the performance of our products!**

3. DIFFERENT TRACER LUMINESCENCE VALUES

- a. Yet another controversial subject. Stemming from the mid 1970's, when Gunson's Sortex (Pty) Ltd. manufactured the first luminescence tracers. These tracers were given the value of an electrical signal that these tracers generated in the optical detection circuit of a Sortex machine. Sortex made tracers in different sizes and with different luminescence levels such as 1000mV (mV standing for a signal amplitude measured in milli Volt), 2000mV etc. I happen do know this particularly well, as I not only

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designed Sortex diamond recovery machines but also introduced x-ray luminescent tracers!

- b. Later on, other X-ray Diamond Recovery machine manufacturers entered the market and continued to use the same “mV” tracer principle.
- c. What has been overlooked in the process, is the fact, that a tracer luminescence value expressed in mV, has only got any comparative relevance if used in a specific x-ray sorter design!
- d. These “original” mV-values had relevance to Sortex X-ray Diamond Recovery machines manufactured in the mid 70’s which all were of the same design!
- e. Today’s x-ray luminescence tracer “mV categories” only indicate their relative luminescence. I.e. a tracer of category 2000mV generates twice as much luminescence than a tracer of category 1000mV.
- f. A specific sorter model’s recovery efficiency of luminescent tracers of a specific ‘mV-rating’ can NOT be used to determine diamond recovery efficiency of this specific sorter model.
- g. It is of utmost importance to establish the luminescence values of diamonds that a specific sorter model has to recover!
 - i. By passing diamonds through the relevant sorter model and recording their luminescence values
 - ii. By measuring the luminescence of diamonds in an X-ray Fluorescence (luminescence) Particle Analyzer (FPA). Such FPA must be calibrated to generate luminescence values relevant to a specific sorter model!
- h. Once the correct diamond luminescence value has been established a tracer with the correct luminescence value must be chosen for this specific application.
- i. Flow Sort offers these services to all its customers, both options, free of charge, being part of sorter commissioning.

4. SUMMARY

- a. Only use Luminescent Tracers in a Flow Sort X-ray recover plant that have been approved by FLOW SORT (PTY) LTD.
- b. Ensure that the tracer luminescence value that you use in is correct for your specific application.
- c. Be warned that the use of **the wrong tracer type** or the **incorrect tracer luminescence value**, for setting-up or checking a Flow Sort X-Ray Diamond Recovery machine will result in poor sorter performance. Most likely the result will be excessive yield, or even worse, poor diamond recovery!
- d. If in **any doubt** regarding the tracers that you are using on a Flow Sort X-ray Diamond Recovery Machine please do not hesitate to contact **FLOW SORT** for clarification and advice, it's free!

Peter WOLF 2006-04-22

p.s.: In the following pages you find details on x-ray luminescent tracers suitable for use on FLOW SORT X-Ray Diamond Recovery Machines.

X-ray luminescent tracers suitable for use with FLOW SORT machines.

1. The FLOW SORT luminescent Marble Tracer

- a. This is the standard Flow Sort X-Ray Diamond Recovery Machine reference tracer.
- b. This spherical shaped tracer not only serves as a luminescence reference but at the same time it also is an excellent tool for checking a Flow Sort's feeding and ejection system!
- c. Flow Sort is successfully using this tracer for over twelve years. Needless to say that a vast reference databank exists for this tracer with references to virtually all diamond deposits in the world.
- d. Flow Sort has published numerous write-ups regarding the use of this specific tracer for setting-up as well as conducting performance checks of Flow Sort diamond recovery machines.

e. Flow Sort Marble Tracer specifications:

- i. Luminescence value when passed through a Flow Sort XR or TSXR model is: **3.0 μlm** (three millionths of a lumen)
 1. For reference note that diamond in the size of +2mm (8 Pointers) typically exhibit a luminescence level higher than 3.0 μlm
- ii. Tracer shape / size is **spherical** with a **12mm** diameter
- iii. Tracer colour / material are **white**, ceramic.
- iv. Specific gravity approx. 2.5
 1. These tracers are NOT suitable for testing an entire diamond processing plant.

- 2. The all new Translucent X-Ray Luminescence Tracers with high density core designed and manufactured by PARTITION ENTERPRISES PTY (LTD)**
- a. These are the only tracers other than Flow Sort's Marble Tracers approved for use on Flow Sort XR & TSXR Sorters!
 - b. As this tracer is **very new** on the market we can not supply any "in the field data" for this tracer.
 - c. We have evaluated these new tracers in our Fluorescent (Luminescence) Particle Analyzer (FPA) and, most importantly, we have tested them in a Flow Sort X-Ray Diamond Recovery machine model XR 2/50 DW.
 - i. Partition Enterprises manufacture this new translucent x-ray luminescence tracers in two sizes, 4mm cubic and 8mm cubic.
 - ii. Both sizes are available in 7 (seven) different luminescent intensity groups.
 - iii. Each intensity group is easily identified by its unique color.
 - iv. Luminescence values are assigned on a scale starting with 1.5625 (orange) increasing in 6 steps of doubling the previous luminescence value i.e. 3.125 (yellow), 6.25 (green), 12.5 (blue), 25 (brown), 50 (pink) reaching its highest luminescence value of 100 (violet).
 - d. The green (6.25) type registers 2 µm compared to the Flow Sort Marble's 3.0 (three) µm.
 - e. The blue (12.5) type registers 4 µm some 30% more than a Flow Sort Marble Tracer.
 - f. The BLUE as well as the GREEN x-ray luminescence / translucent tracer types manufactured by Partition Enterprises are suitable alternatives to the Flow Sort Marble Tracers.**
 - g. These tracers are suitable for use on Flow Sort X-Ray Diamond Recovery machines. This applies to both tracer sizes, the 4mm³ as well as the 8mm³.**
 - h. Please be sure to use only genuine Partition Enterprises Tracers. Don't use any 'look-alikes' or fake's. Unfortunately we do not have specific order codes for these new tracers. Make sure that you only use the NEW 'Translucent-type tracers and not any of the earlier versions!**

i. Partition Enterprises new GREEN Luminescence Tracer specifications:

- i. Luminescence value when passed through a Flow Sort XR or TSXR model is: **2.0 μm** (two millionths of a lumen)
 1. Most diamond in the size of +1.5mm (5 Pointers) exhibit a luminescence level above 2.0 μm
- ii. Tracer shape / size is **cubic** with a **4mm or 8mm** edge length
- iii. Tracer colour / material is **green, resin with heavy core.**
 1. These tracers are available with non-magnetic as well as with ferromagnetic cores
- iv. Specific gravity approx. 3.5
 1. These tracers **ARE** suitable for testing an entire diamond processing plant.

j. Partition Enterprises new BLUE Luminescence Tracer specifications:

- i. Luminescence value when passed through a Flow Sort XR or TSXR model is: **4.0 μm** (four millionths of a lumen)
 1. Most diamond in the size of +2mm (10 Pointers) exhibit a luminescence level above 4.0 μm
- ii. Tracer shape / size is **cubic** with a **4mm or 8mm** edge length
- iii. Tracer colour / material is **blue, resin with heavy core.**
 1. These tracers are available with non-magnetic as well as with ferromagnetic cores
- iv. Specific gravity approx. 3.5
 1. These tracers **ARE** suitable for testing an entire diamond processing plant.

3. Take note that Flow Sort's standard sorter set-up / sorter test procedure is based on Flow Sort Marble Tracers.
 - a. This procedure must be modified to suit either one of the two different Partition Enterprises luminescence tracer categories.
4. Please contact FLOW SORT for more information on this new product.