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DIAMOND SIMULANTS

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(57) Claim

1.
A diamond simulant for use in monitoring the efficiency of a diamond recovery process, the simulant comprising a synthetic, cast ceramic body containing additives which are included to give the ceramic body density and X-ray luminescence properties similar t those of diamond.

2.
A diamond simulant according to claim 1 wherein the ceramic body contains calcium tungstate as an additive giving the ceramic body X-ray luminescence properties similar to those of diamond.

3.
A diamond simulant according to either one of the

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preceding claims wherein the ceramic body contains inert fillers of appropriate density giving the ceramic body a density similar to that of diamond.

7.
A diamond-in-kimberlite simulant comprising a diamond simulant according to any one of the preceding claims encapsulated in a host body of wonderstone.

8.
A method of monitoring the efficiency of a dense medium separation or X-ray sorting stage in a diamond recovery process, the method comprising subjecting diamond simulants according to any one of claims 1 to 3 to the dense medium separation or X-ray sorting stage and monitoring the effect of the dense medium or X-ray sorting stage on the diamond simulants.

9.
A method of monitoring the efficiency of a mechanical comminution stage in a diamond recovery process, the method comprising subjecting diamond-in-kimberlite simulants according to claim 7 to the mechanical comminution stage and monitoring the effect of the mechanical comminution stage on the diamond-in-kimberlite simulants.

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COMPLETE SPECIFICATION

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This document contains the amendments made under Section 49 and is correct for printing.

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COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

Diamond simulants

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

BACKGROUND TO THE INVENTION

THIS invention relates to diamond simulants and to a process monitoring method which uses such simulants to monitor the efficiency of a process in which diamonds are recovered from their ores.

A typical recovery process for recovering natural diamonds from their ores involves three stages. In the first stage, the diamonds are liberated from their host rock by mechanical comminution using crushers or mills. In the second stage, the liberated diamonds are concentrated. In the third stage, the concentrate is treated to recover a near-pure diamond product.

It is common for the liberation process to be conducted in mechanical comminution devices such as crushers and mills. Dense medium separation (DMS) is commonly used for the concentration stage, and X-ray or grease recovery techniques for the final recovery stage(s).

DMS is a simple 'sink-float' process which takes place in a dense fluid. Since diamond has a higher density than most of the minerals associated with it in the ore, correct operation of the DMS process allows a diamond-rich concentrate to report with the 'sink' fraction.

A near-pure diamond product may be recovered from this concentrate by passing the diamondiferous material through an X-ray sorter. Here, the particles are exposed to X-radiation, which causes the diamonds to luminesce. This luminescence may be detected and the detected signal may be used to operate devices which selectively separate the diamonds from other particles.

Alternatively, a near-pure diamond product may be recovered by passing a stream of the diamondiferous material over a surface coated with petroleum or similar grease. Diamond is hydrophobic and attaches itself to the grease. The non-diamond particles pass over the grease. The grease/diamond mixture may then be treated to recover the diamonds.

The monetary value of diamonds dictates that close control needs to be maintained over each of the processing stages to ensure optimum economic diamond liberation and recovery. The paucity of natural diamonds in their ores (often measured in parts per billion in mass terms) means that the diamonds themselves are not good statistical indicators of performance of a diamond recovery plant.

It is, therefore, desirable to use diamond simulants for evaluating process performance. The simulants must have properties which emulate those of diamond under the same conditions. Monitoring and/or recovery of these simulants within a treatment plant can be used to determine diamond recovery performance.

The present invention seeks to provide simulants for use in monitoring the efficiency of a diamond recovery process. The invention also seeks to provide a method for monitoring the efficiency of a diamond recovery process.

SUMMARY OF THE INVENTION

According to a first aspect of the invention, there is provided a diamond simulant for use in monitoring the efficiency of a diamond recovery process, the simulant comprising a synthetic, cast ceramic body containing additives which included to give the ceramic body density and X-ray luminescence properties similar to those of diamond.

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According to a second aspect, the invention extends to a diamond-in-kimberlite simulant which comprises a ceramic diamond simulant as defined above encapsulated in a host body of wonderstone.

The invention also provides a method for monitoring the efficiency of a dense medium separation or X-ray sorting stage in a diamond recovery process, the method comprising subjecting a diamond simulant as defined above to the dense medium separation or X-ray sorting stage and monitoring the effect of the dense medium or X-ray sorting stage on the diamond simulant.

In particular, the invention provides a method of monitoring the efficiency of a mechanical continuation stage in a diamond recovery process, the method comprising subjecting a diamond-in-kimberlite simulant as defined above to the mechanical continuation stage and monitoring the effect of the mechanical continuation stage on the diamond-in-kimberlite stimulant.

SPECIFIC DESCRIPTION

According to first aspect of the invention, diamond is simulated by means of a suitable ceramic material. While no readily available and workable material has a hardness approaching that of diamond, hard ceramics can provide a suitable compromise. The following composition (by weight) provides an example of a ceramic which is suitable for use in the present invention:

Al_2O_3	88% by weight
CaO	1.5% by weight
MgO	1.5% by weight
SiO_2	balance

The use of ceramic material to simulate the diamond has the distinct advantage that the ceramic material may be cast in such a manner that the resulting particle has size, shape and surface characteristics approximating that of diamond

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with sufficient accuracy for the monitoring of a diamond recovery process. Another advantage is that various additives can be incorporated in the ceramic mixture prior to casting, such additives being chosen to give the resultant ceramic particle other properties similar to the corresponding properties of diamond.

For instance, a ceramic particle ~~may be created~~ having density and X-ray luminescence properties similar to those of diamond may be created by the incorporation in the mix of a suitably dense material and/or a material having an X-ray luminescence response similar to that of diamond. One material suitable for endowing the particle with appropriate X-ray luminescence properties is calcium tungstate, while inert fillers of appropriate density can be used to adjust the density of the resultant ceramic particle to the desired level.

In a case where the ceramic diamond simulant is to be used in the monitoring of a process involving a magnetic separation stage, appropriate magnetic material can be added to the ceramic mix before casting to form the ceramic particle. In a case where a grease table is used in the process, the ceramic simulant can have a hydrophobic coating applied to it. Another significant advantage of using a ceramic as a diamond simulant is the fact that it is possible to add colourants to the ceramic mix before casting. The progress of the coloured particles through the diamond recovery process can then be monitored.

The invention extends to a diamond-in-kimberlite simulant which will be useful in monitoring the efficiency of a diamond liberation stage involving the use of mechanical crushers or the like. In this case, it is proposed to

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encapsulate the ceramic diamond simulant in a host body of wonderstone. Wonderstone, which is a hydrostatically pressed, calcined pyrophyllite, has certain mechanical properties which are known to approximate those of kimberlite which is the normal host rock for non-alluvial diamonds. The passage of a diamond-in-kimberlite simulant of this kind through the mechanical comminution stage can give a reasonably reliable indication of the efficiency of that stage.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1.
A diamond simulant for use in monitoring the efficiency of a diamond recovery process, the simulant comprising a synthetic, cast ceramic body containing additives which are included to give the ceramic body density and X-ray luminescence properties similar to those of diamond.

2.
A diamond simulant according to claim 1 wherein the ceramic body contains calcium tungstate as an additive giving the ceramic body X-ray luminescence properties similar to those of diamond.

3.
A diamond simulant according to either one of the preceding claims wherein the ceramic body contains inert fillers of appropriate density giving the ceramic body a density similar to that of diamond.

4.
A diamond simulant according to any one of the preceding claims wherein the cast ceramic body is coated with a hydrophobic coating.

5.
A diamond simulant according to any one of the preceding claims wherein the ceramic body includes a colourant.

6.
A diamond simulant according to any one of the preceding claims wherein the ceramic body includes magnetic

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material.

7.
A diamond-in-kimberlite simulant comprising a diamond simulant according to any one of the preceding claims encapsulated in a host body of wonderstone.

8.
A method of monitoring the efficiency of a dense medium separation or X-ray sorting stage in a diamond recovery process, the method comprising subjecting diamond simulants according to any one of claims 1 to 3 to the dense medium separation or X-ray sorting stage and monitoring the effect of the dense medium or X-ray sorting stage on the diamond simulants.

9.
A method of monitoring the efficiency of a mechanical comminution stage in a diamond recovery process, the method comprising subjecting diamond-in-kimberlite simulants according to claim 7 to the mechanical comminution stage and monitoring the effect of the mechanical comminution stage on the diamond-in-kimberlite simulants.

DATED this 25th day of January, 1991
De Beers Industrial Diamond Division (Proprietary) Limited
By Its Patent Attorneys
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