

B03D

FLOTATION; DIFFERENTIAL SEDIMENTATION (sedimentation in general [B01D 21/00](#); in combination with other separation of solids [B03B](#); sink-float separation [B03B 5/28](#); detergents, soaps [C11D](#))

Definition statement

This place covers:

Apparatus or methods using liquids for the separation of solids from solids, such apparatus or methods consisting of the following:

Flotation type separation apparatus or methods that may include one or more of the following:

- Chemical and mechanical aspects such as flotation agents (organic, inorganic or macromolecular), where the agents can act as collectors, frothers or depressants and the material treated by the flotation agent could be an ore, e.g. a coal or phosphate ore;
- Froth-flotation processes;
- Flotation machines, including pneumatic machines and machines with impellers;
- Subaeration machines;
- Subsequent treatment of concentrated product; and
- Agent recovery.
- Differential sedimentation type separation apparatus or methods that may include coagulation or flocculation.

Relationships with other classification places

In Section [B](#), the separation of different materials, e.g. of different matter, size or state, is predominantly found in the following subclasses: [B01D](#), [B03B](#), [B03C](#), [B03D](#), [B04B](#), [B04C](#), [B07B](#), [B07C](#).

The classifying characteristics of these subclasses are:

- The physical state of the matter to be separated.
- The principle of the process used.
- Particular kinds of apparatus.

The first of these characteristics involves six different aspects, assembled in three groups:

- Liquid/liquid or liquid/gas and gas/gas.
- Solid/liquid or solid/gas.
- Solid/solid.

These subclasses are to be used according to the following general rules:

[B01D](#) is the most general subclass as far as separation other than solids from solids is concerned.

Apparatus for separating solids from solids are covered by [B03B](#) when the process concerned is regarded as the equivalent of "washing" in the sense of the mining art, even if such apparatus is a pneumatic one, especially pneumatic tables or jigs. Screens per se are not covered by this subclass but are classified in [B07B](#), even if they are being used in a wet process. All other apparatus for the separation of solids from solids according to dry methods are classified in [B07B](#).

If the separation takes place as a result of the detection or measurement of some feature of the material or articles to be sorted it is classified in [B07C](#).

It should also be noted that the separation of isotopes of the same chemical element is covered by [B01D 59/00](#), whatever process or apparatus is employed.

References

Limiting references

This place does not cover:

Combinations of dry separating apparatus with wet separating apparatus	B03B
Sink-float separation	B03B 5/28

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

Separating isotopes	B01D 59/00
Treatment of water, waste water or sewage by flotation	C02F 1/24
Flotation apparatus for enzymology or microbiology	C12M 1/09

Informative references

Attention is drawn to the following places, which may be of interest for search:

Processes or devices capable of general use, for removing adhering liquid from separated materials	B01D
Froth dispersion	B01D 19/02
Sedimentation in general	B01D 21/00
Devices for feeding measured quantities of reagents	B01J 4/02
Conditioners	B03B 1/00
Centrifuges	B04B
Separating by dry methods	B07
Detergents, soaps	C11D

Special rules of classification

In groups [B03D 1/001-B03D 1/018](#), in the absence of an indication to the contrary, classification is made in the last appropriate place.

In groups [B03D 1/001-B03D 1/018](#), it is desirable to add the appropriate Indexing Code(s) from each of the groups [B03D 2201/00](#) or [B03D 2203/00](#).

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Coagulation	The process by which a liquid changes to a thickened, curdlike, insoluble state by some kind of chemical or physical process, excluding by evaporation.
Differential sedimentation	A separation process using gravity or centrifugal force to initiate differential settling of suspended solids, for example at the bottom of a tank. Different solid materials settle at different rates.

Flocculation	This refers to a process where a solute comes out of solution in the form of floc or "flakes". The term is also used to refer to the process by which fine particulates are caused to clump together into floc. The floc may then float to the top of the liquid, settle to the bottom of the liquid, or can be readily filtered from the liquid. Sodium silicate is a common flocculating agent.
Flotation	(Also known as froth flotation) A separation process whereby water and chemicals are added to a mixture of solids to form a pulp while developing differences in surface tension between the various species in the solids mixture. The pulp is then copiously aerated and the preferred (aerophilic) species clings to bubbles and floats as a mineralized froth, which is then skimmed off.

B03D 1/00

Flotation (conditioning for flotation, general arrangement of plan [B03B](#))

Definition statement

This place covers:

Flotation type separation apparatus or methods that include one or more of the following:

- Flotation agents according to the chemical constituents
- Froth-flotation processes, i.e., carrier flotation, flotation processes adapted for the flotation of fines, control of flotation processes;
- Agent recovery;
- Flotation machines, including pneumatic machines, machines with impellers, electroflotation machines, flotation machines using centrifugal forces, reactor-separator types and dissolved air flotation machines;
- Subsequent treatment of the froth, the feed and the tailings;
- Feed and discharge mechanisms for the material flow streams involved (feed, froth, sediments, reagents, pulp),
- Structural elements such as baffles and plates inside the flotation tank and

Relationships with other classification places

Documents which are primordially directed to the fields of separation of non-miscible liquids by gas bubbles or moving solids ([B01D 17/0205](#)), paper pulp processing ([D21F 1/70](#)), de-inking of paper pulp ([D21B 1/325](#)), the treatment of water, waste water, sewage, or sludge by flotation ([C02F 1/24](#)), separation of suspended solid particles from liquids by sedimentation ([B01D 21/0084](#)) or other technical fields relating to the application of the apparatuses should only be classified in [B03D 1/00](#) if the device disclosed therein shows structural details of general interest in [B03D 1/00](#).

Documents, where the principal separation method is another separation technique and flotation is merely a side aspect, should not be classified in [B03D 1/00](#). Examples are the separation of oil and water with coalescing means whereby the efficiency is enhanced by introducing bubbles into the liquid ([B01D 17/0205](#)), or introducing gas bubbles in a limited region of the sedimentation device, e.g. close to the discharge opening for the clarified liquid ([B01D 21/0084](#)).

References

Limiting references

This place does not cover:

Foam dispersion	B01D 19/02
Separation of liquids and solids by sedimentation	B01D 21/00

Mixing gases and vapours with liquids	B01F 3/00
Mixing according to the phases to be mixed	B01F 3/04
Devices for feeding measured quantities of reagents	B01J 4/02
Conditioners	B03B 1/00
Sink-float separation	B03B 5/28
General arrangement of separating plant	B03B 9/00
Treatment of water, waste water, sewage, or sludge by flotation when no structural details of general interest are disclosed.	C02F 1/24
Electroflotation in waste water treatment	C02F 1/465

Informative references

Attention is drawn to the following places, which may be of interest for search:

Mixing, dispersing, emulsifying	B01F
Cyclones	B04C
Treatment of water, waste water, sewage, or sludge by flotation.	C02F 1/24
Use of agglomerated or waste materials such as fly ash	C04B 18/08
Production and refining metals	C22B

Special rules of classification

In groups [B03D 1/001](#) - [B03D 1/018](#), in the absence of an indication to the contrary, classification of a single substance is made in the last appropriate place. For mixtures of substances, each substance is classified in the last appropriate place. Subordinate components e.g. merely mentioning the presence of a polyether frother, may only receive a class in the indexing scheme.

Except for the rule mentioned above, a document receives an appropriate class or index for every feature of the device or process.

Indexing schemes belonging to this group: [B03D 1/00](#), [B03D 2201/00](#) and [B03D 2203/00](#)

Features relating to flotation but which have subordinate importance in the document concerned should be classified in the indexing scheme [B03D 1/00](#). Thus, documents disclosing the mere presence of a flotation device, e.g. a schematic block in a process flow diagram, or disclosing the mere presence of a technical feature, e.g. a schematic block indicating a nozzle should receive an appropriate index from the indexing scheme [B03D 1/00](#) if no more appropriate class (e.g. [C02F 1/24](#) or [D21F 1/70](#)) can be found in the technical fields of application.

Specified effects produced by the flotation agent should be classified in [B03D 2201/00](#).

Specified materials treated by the flotation agent or flotation applications should be classified in [B03D 2203/00](#).

Both trivial and systematic names for minerals are frequently used in the file.

For the flotation agents, trivial and systematic names as well as registered trade names are frequently used in the file.

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Coagulation	Formation of aggregates of particles, the coagula, induced by substances for reducing interparticle repulsion forces, such as an electrolyte.
Flocculation	Formation of aggregates of particles, the flocs or "flakes", induced by a bridging action of large molecules, such as modified starch or polymers.
Agglomeration	Formation of aggregates of particles, the agglomerates, induced by a bridging liquid such as oil.
Flotation	Froth flotation (or simply flotation) is a physico-chemical separation process that utilises the effect that different materials normally show also differences in surface properties (e.g. surface tension), for separating a mixture of materials into its fractions. This difference in surface properties yields in a different tendency of the particles to attach to air bubbles. The surface properties are often modified so as to achieve a desired behaviour of a material fraction. Froth flotation involves thus three phases (solids, water, gas) with complex interactions and subprocesses. In a typical flotation process water and chemicals are added to a mixture of solids to form a pulp. The pulp is then copiously aerated and the preferred (aerophilic) species clings to bubbles and floats as a mineralized froth, which is then skimmed off.
Collector	Substance for modifying the surface properties of a specified material (e.g the ore) so as to enhance floatability. It involves hydrophobising the particle surface by adsorption of molecules or ions.
Frother	Substance for stabilising the bubbles when reaching the surface of the pulp by forming a layer of reasonably stable froth, thus preventing remixing of the floated fraction.
Depressant	Substance for modifying the surface properties of a specified material (e.g the gangue) so as to reduce floatability.
Dispersant	Substance for preventing unwanted aggregation of the solid fractions, e.g. for enhancing the selectivity of the flotation process.
Coagulants and Flocculants	Substance for increasing the particle size such as to induce flocculation, coagulation or agglomeration, e.g. for flotation processes for water purification or for fine particle processing.
Modifying reagents	Substances (other than depressants, dispersants, coagulants and flocculants) for controlling the physico-chemical state of the flotation process e.g. the pH, conductivity etc. or altering the effect of the other chemicals i.e. the collector or the frother.

B03D 1/001

Flotation agents (conditioners [B03B 1/00](#))

References**Limiting references**

This place does not cover:

Conditioners	B03B 1/00
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B03D 1/08

Subsequent treatment of concentrated product (froth dispersion [B01D 19/02](#))

References**Limiting references**

This place does not cover:

Froth dispersion	B01D 19/02
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B03D 1/14

Flotation machines (devices for feeding measured quantities of reagents [B01J 4/02](#); flotation apparatus for enzymology or microbiology [C12M 1/09](#))

References**Limiting references**

This place does not cover:

Devices for feeding measured quantities of reagents	B01J 4/02
Flotation apparatus for enzymology or microbiology	C12M 1/09

B03D 1/1437

{using electroflotation (waste water treatment using electroflotation [C02F 1/465](#))}

References**Limiting references**

This place does not cover:

Waste water treatment using electroflotation	C02F 1/465
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B03D 1/145

{Feed mechanisms for reagents (devices for feeding measured quantities of reagents [B01J 4/02](#))}

References**Limiting references**

This place does not cover:

Devices for feeding measured quantities of reagents	B01J 4/02
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B03D 1/16

with impellers; Subaeration machines {(mixing gases or vapours with liquids [B01F 3/04](#))}

References**Limiting references**

This place does not cover:

Mixing gases or vapours with liquids	B01F 3/04
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B03D 1/24

Pneumatic {(mixing gases or vapours with liquids [B01F 3/04](#))}

References**Limiting references**

This place does not cover:

Mixing gases or vapours with liquids	B01F 3/04
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B03D 3/00**Differential sedimentation****Definition statement**

This place covers:

Differential sedimentation is used for separating a mixture of particulate material into its fractions (for a definition of differential sedimentation, refer to the glossary of terms).

Differential sedimentation type separation apparatus or methods that may include coagulation or flocculation.

Relationships with other classification places

Separation of suspended particles from liquids by sedimentation ([B01D 21/00](#)) is directed to the separation of liquids and particles whereas differential sedimentation uses a liquid as a separation aid with the objective to separate the fractions of a mixture of particles.

Sink-float classifiers ([B03B 5/28](#)) use a liquid which has a density in between of the different fractions of a mixture of particles for separating the mixture into its fractions. In differential sedimentation, all fractions should in principle be able to settle so as to form a layered sediment.

References

Limiting references

This place does not cover:

Separation of suspended particles from liquids by sedimentation	B01D 21/00
Sink-float classifiers	B03B 5/28
Hydraulic classifiers	B03B 5/62

Informative references

Attention is drawn to the following places, which may be of interest for search:

Nanotechnology materials (e.g. carbon nanotubes)	B82Y 30/00
Purification of carbon nanotubes	C01B 32/17
Investigating particle size or size distribution by investigating the sedimentation of particle suspensions (e.g. sedimentometers)	G01N 15/04
Investigating or analysing materials	G01N 33/00

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Coagulation	Formation of aggregates of particles, the coagula, induced by substances for reducing interparticle repulsion forces, such as an electrolyte.
Flocculation	Formation of aggregates of particles, the flocs or "flakes", induced by a bridging action of large molecules, such as modified starch or polymers.
Agglomeration	Formation of aggregates of particles, the agglomerates, induced by a bridging liquid such as oil.
Differential sedimentation	Differential sedimentation exploits the different sedimentation velocities of the particles belonging to different fractions of a mixture of particles, for separating the mixture into its fractions. When introducing a mixture of particles into a medium, e.g. a liquid, the fraction of particles showing a high sedimentation velocity will settle in a first, bottom layer whilst the fractions of particles showing a low sedimentation velocity will settle on top of that first layer. The liquid in differential sedimentation is used as a separation aid. The objective of this process is thus particle classification as opposed to the process of separating liquid from particles by sedimentation. The driving force for sedimentation is usually gravity or centrifugal force.
Differential centrifugal	sedimentation