

Apparatus and Method For Recycling Electrolytes

Technical Field

5 The present application relates to battery recycling technology. In particular, the present application relates to an apparatus and a method for recycling electrolytes from batteries.

Background

10 Batteries such as lithium batteries have becoming one of the most widely used mobile energy sources in many industrial and daily life applications. With the usage of batteries greatly increasing, aged and discarded batteries have become a major issue of environmental concern and sustainability of social developments. Industrial players have
15 been endeavoured with continuous efforts in developing effective and practical solutions for battery recycling for the purposed of possible environmental pollutions reduction and better reusage of the precise metals and other materials from the recycled battery parts.

20 Present battery recycling technologies mainly focus on electrode recycling hence less solution is available for electrolyte recycling. Due to the presence of electrolytes in most of batteries, limited known electrolyte recycling process encounter problems of, for example, short circuits, burning, explosion etc during transportation and storage of batteries selected for recycling. Battery discharge treatment by soaking in chemical
25 solutions also faces the problems of low productivity and in addition, hazardous gases generated during the soaking process also give arise to environmental concerns.

 It is therefore desirable to provide an improved electrolyte recycling apparatus and method to solve at least one of the problems identified above.

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Summary

According to one aspect, the present invention provides an apparatus for recycling electrolytes from batteries. In one embodiment, the apparatus comprises a housing which encloses a vacuum chamber therein, a filter plate disposed in the housing, a gate formed on the housing and a press coupled to the housing. The filter plate divides the vacuum chamber into a first compartment and a second compartment. The gate is openable to allow external access to the first compartment, for loading the battery fragments into the vacuum chamber for electrolyte recycling and unloading the solid contents of the fragments from the vacuum chamber thereafter, and closeable to seal the vacuum chamber. After the battery fragments are loaded into the first compartment through the gate and the gate closed, the press is driven to move towards the filter plate to squeeze the battery fragments and to force electrolytes to flow out of the fragments. The electrolytes thereafter flow into the second compartment through the filter plate for collection.

Preferably, the apparatus further comprises a waste gas treatment unit connected to the first compartment for collecting air generated in the vacuum chamber.

Preferably, the apparatus further comprises a heater disposed in the first compartment for controlling a temperature of the first compartment.

Preferably, the apparatus further comprises a discharge port formed at the bottom portion of the second compartment for collection of electrolytes.

Preferably, the apparatus further comprises a vacuum pump connected to the vacuum chamber for maintaining a vacuum status in the vacuum chamber.

According to another aspect, the present invention provides a method for recycling electrolytes from batteries. In one embodiment, the method comprises loading fragments of batteries into a first compartment of the vacuum chamber, in which the fragments include solid contents and electrolytes obtained from the batteries; squeezing the fragments in the first compartment of the vacuum chamber to cause the electrolytes to

flow out of the fragments; and separating the electrolytes from the solid contents, and collecting the electrolytes.

Preferably, squeezing the fragment comprises pressing the fragments against a filter plate in the vacuum chamber.

Preferably, separating the electrolytes from the solid contents comprises allowing the electrolytes to flow through a filter plate and retaining the solid contents by the filter plate.

Preferably, the method further comprises extracting air generated in the vacuum chamber, in which the air includes waste gas generated during squeezing the fragments in the first compartment of the vacuum chamber.

Preferably, the method comprises converting the waste gas into clean air and discharge the clean air.

With the solutions provided by the present application, the present invention enables electrolytes recycling by effectively separating the electrolytes from the rest parts of the battery fragments. Possible battery burning or explosion during the cutting and fragmentation process are effectively avoided, and the waste gas generated during the electrolyte recycling is better controlled.

Brief Description of Drawings

The technical solutions and corresponding technical features of the embodiments will be more comprehensively understood in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic diagram showing an apparatus for recycling electrolytes from batteries according to one embodiment of the present invention;

Fig. 2 is a flow chart showing a method for recycling electrolytes from batteries according to one embodiment of the present invention;

Fig. 3 is a flow chart showing an exemplary detailed step of the method shown in Fig. 2;

Fig. 4 is a flow chart showing an exemplary detailed step of the method shown in Fig. 2;

5 Fig. 5 is a flow chart showing an exemplary further step of the method shown in Fig. 2;

Fig. 6 is a flow chart showing an exemplary further step of the method shown in Fig. 2.

10 Detailed Description

As shown in Fig. 1, according to one embodiment of the present invention, an apparatus 200 for recycling electrodes from batteries comprises a housing 210 which encloses a vacuum chamber 220, a filter plate 230 disposed in the housing 210, a gate 240
15 formed on the housing 210, and a press 250 coupled to the housing 210. The filter plate 230 divides the vacuum chamber 220 into a first compartment 224 and a second compartment 226, with the second compartment 226 positioned below the first compartment 224. The gate 240 is openable for loading and unloading, and closable to maintain the sealing state of the vacuum chamber 220. Upon being opened, the gate 240
20 allows external access to the first compartment 224, for loading of battery fragments 80 into the first compartment 224, and unloading the solid contents 82 after separation of the electrolyte 86. Upon being closed, the gate 240 seals the vacuum chamber 220 to maintain the vacuum state in the vacuum chamber 220.

25 The press 250 is movable in the first compartment 224 relative to the housing 210, towards the filter plate 230 at a pressing direction 251, and away from the filter plate 230 at a retracting direction 259, to vary a volume of the first compartment 224. In the process of moving towards the filter plate 230, the press 250 is brought into contact with the battery fragments 80 loaded into the first compartment 224 through the gate 240, and
30 presses the battery fragments 80 against the filter plate 230.

Driven by a powered mechanism 252, the press 250 exerts a pressure against the battery fragments 80 and with the support of the filter plate 230, the press 250 squeezes

the battery fragments 80 and forces the electrolytes 86 to flow out of the battery fragments 80. With the support effect of the filter plate 230, the electrolytes 86 in liquid form pass through the filter plate 230 and enter the second compartment 226. After the electrolytes 86 are squeezed out, the residue solid content 82 e.g. electrodes, separators, etc. of the battery fragments 80 may be unloaded through the gate 240, for e.g. a separate process of electrode recycling.

The apparatus 200 may further comprise a waste gas treatment unit 270 connected to the first compartment 224, for collecting the waste gas or air generated in the vacuum chamber 220. Additionally, the apparatus 200 may comprise a vacuum pump 280 to expel the air from the waste gas treatment unit 270. Further, the apparatus may comprise a chamber pump 290 connected to the vacuum chamber 210 for maintaining a vacuum status in the vacuum chamber 210.

The apparatus 100 may further comprise a heater 260 disposed in the first compartment 224, for controlling a temperature of the first compartment 224. The apparatus 100 may further comprise a discharge port 228 formed at the bottom portion of the second compartment 226, for collection of electrolytes 86 received in the second compartment 226.

As shown in Fig. 2, according to one embodiment of the present invention, a method 300 for recycling electrolytes from batteries comprises, a step 320 of loading fragments of batteries into a first compartment of the vacuum chamber. The fragments include solid contents such as electrodes and separators etc., and electrolytes, obtained from aged or discarded batteries. At step 330, the method 300 squeezes the fragments in the first compartment of the vacuum chamber, to cause the electrolytes to flow out of the fragments. At step 340, the method 300 separates the electrolytes from the solid contents and at step 350, the method 300 collects the electrolytes obtained from the previous steps.

Preferably, as shown in Fig. 3, the step 330 of squeezing the fragment comprises a step 332 of pressing the fragments against a filter plate in the vacuum chamber.

Preferably, as shown in Fig. 4, the step 340 of separating the electrolytes from the solid contents comprises a step 342 of allowing the electrolytes to flow through a filter plate and retaining the solid contents by the filter plate.

5 Preferably, as shown in Fig. 5, the method 300 further comprises a step 360 of extracting air generated in the vacuum chamber, which includes waste gas generated during squeezing the fragments in the first compartment of the vacuum chamber.

10 Preferably, as shown in Fig. 6, the method 300 further comprises a step 370 of converting the waste gas into clean air and discharge the clean air.

15 This disclosure has been presented for purposes of illustration and description of the embodiments of the present invention, but is not intended to be exhaustive or limiting. For example, while the present invention is presented by making reference to one type of battery as illustrated in the drawings and the description, it should be appreciated that the present invention may be practiced for batteries of various other types, other structures
20 other models and other architectures. Many modifications and variations will be apparent to those of ordinary skilled in the art. The example embodiments are chosen and described to explain principles and practical application of the present invention, and to enable those of ordinary skilled in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular technical solution contemplated and described. Further, while some technical details may be omitted from the description and drawings, for the purpose of clarity and conciseness, such omissions are not meant to be understood that the omitted features are necessarily absent or missing
25 in the relevant structures, parts, processes and/or steps, as described herein, for understanding and practicing the invention.

30 Thus, although illustrative example embodiments have been described herein with reference to the accompanying drawings, it is to be understood that this description is not limiting and that various other changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the disclosure as sets out and defined the claims appended hereto.

Claims

1. An apparatus for recycling electrolytes, the apparatus comprising:
 - a housing enclosing a vacuum chamber therein;
 - 5 a filter plate disposed in the housing and dividing the vacuum chamber into a first compartment and a second compartment, wherein the second compartment is positioned below the first compartment;
 - a gate formed on the housing, wherein the gate is openable to allow external access to the first compartment for loading and unloading, and closeable to seal the vacuum chamber;
 - 10 a press coupled to the housing, wherein the press is movable relative to the housing towards and away from the filter plate to vary a volume of the first compartment;
 - wherein movement of the press towards the filter plate squeezes battery fragments loaded in the first compartment to force electrolytes to flow out of the fragments and to enter the second compartment through the filter plate.
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2. The apparatus as recited in claim 1, further comprising a waste gas treatment unit connected to the first compartment for collecting air generated in the vacuum chamber.
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3. The apparatus as recited in claim 1, further comprising a heater disposed in the first compartment for controlling a temperature of the first compartment.
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4. The apparatus as recited in claim 1, further comprising a discharge port formed at the bottom portion of the second compartment for collection of electrolytes.
5. The apparatus as recited in claim 1, further comprising a chamber pump connected to the vacuum chamber for maintaining a vacuum status in the vacuum chamber.
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6. A method for recycling electrolytes from a battery, the method comprising:

loading fragments of batteries into a first compartment of the vacuum chamber,
wherein the fragments include solid contents and electrolytes obtained from
the batteries;

squeezing the fragments in the first compartment of the vacuum chamber to
cause the electrolytes to flow out of the fragments;
separating the electrolytes from the solid contents, and
collecting the electrolytes.

7. The method as recited in claim 6, wherein squeezing the fragment comprising
pressing the fragments against a filter plate in the vacuum chamber.

8. The method as recited in claim 7 wherein separating the electrolytes from the solid
contents comprises allowing the electrolytes to flow through a filter plate and
retaining the solid contents by the filter plate.

9. The method as recited in claim 6, further comprising extracting air generated in the
vacuum chamber, wherein the air includes waste gas generated during squeezing the
fragments in the first compartment of the vacuum chamber.

10. The method as recited in claim 8, further comprising converting the waste gas into
clean air and discharge the clean air.