METHOD OF TREATING FEED MATERIAL, AND USE OF THE METHOD

A method is described for the treatment of feed material in the form of pellets, or clump or sheet formed starting materials for such feed materials, which shall be supplied to an organism, where a volume of the feed material in a container, for supply of necessary supplementary substances to the feed material, is subjected to an under-pressure over a given time period, for venting of gases/air in the pores/void spaces of the feed material, after which the container is subjected to a higher pressure than atmospheric pressure whereby the necessary supplementary substances are forced into the void spaces and pores of the feed material.

The method according to the invention is characterised in that the supplementary substances, in the form of a liquid, or dissolved or suspended in the liquid, are added to the container/feed material prior to the treatment, so that the feed material is subjected to the under-pressure while it is in an excess fluid. An application of the method is also described.
METHOD OF TREATING FEED MATERIALS, AND USE OF THE METHOD

The present invention relates to a method for treatment of feed materials of a pellet form, or of clump or sheet formed starting materials of such feed materials, which shall be given to an organism, where a volume of the feed material in a container for supply of necessary supplementary substances to the feed material, is subjected to an under-pressure over a given period of time for venting of gases/air in the pores/void spaces in the feed material, whereupon the container is subjected to a higher pressure than atmospheric pressure, whereby the necessary supplementary materials penetrate the void spaces and pores of the feed material, i.e. such as it is described in the introduction to the subsequent claim 1.

The invention also relates to an application of the method.

To impregnate feed particles with substances such as vitamins and the like, which shall be given by means of the feed to marine organisms, such as fish, is previously known. So-called vacuum coaters are used for this during the manufacture of the feed. These are used in that a container which is filled with feed particles, is subjected to an under-pressure, possible a vacuum, so that the particles mainly let the air out of the pores and the air is removed. The under-pressure is maintained, and the material one wishes to impregnate the feed particles with, is fed into the container with a simultaneous increase in
the pressure. Then, this material will be forced into the pores of the feed particle.

However this method is not particularly well suited to this purpose. It is based on accurate dosage of small amounts of liquids. In addition, it requires large vacuum pumps, as large volumes of air must be sucked out before a desired vacuum is obtained.

As an alternative method, one can use an overpressure to force water into the fish feed. The disadvantage with this is that air compressed in the fish feed will be able to force water out of the fish feed when the overpressure is removed and returns to atmospheric pressure. This can lead to vitamins, minerals, colouring materials and other supplementary ingredients being forced out of the pellet and disappearing out of the fish feed with the water.


It is therefore, an object of the invention to provide a new solution to impregnate feed particles or starting materials to such particles with one or more substances that is to be given to an organism, such as a fish.

It is also an object of the invention to provide a new method for treatment of feed pellets, or starting materials of feed pellets, whereby, in a simple way, one can add nutrient substances and other materials which the fish can have a need for, such as vitamins, medicines, minerals and the like, or a liquid such as clean fresh water or salt water to the feed material.

The method according to the invention is characterised in that the supplementary materials, in the form of a liquid, or dissolved or suspended in the liquid, is fed to the container/feed material before the treatment, so that the feed material is subjected to the under-pressure while it is in an excess of liquid.
Further preferred embodiments of the method according to the invention are as defined in the dependent claims 2-9.

As mentioned in the claims, the applied liquid can comprise fatty substances, oil, fresh water, or salt containing water, which one wishes to add to the feed material. Furthermore, the liquid can be water or oils that contain vitamins, medicines, colouring substances, minerals and the like in a dissolved form.

According to a further aspect of the invention, the method is applied to the manufacture of fish feed, and in a feeding installation as described in the claims 10-12.

Consequently, according to the invention, the required supplementary substance(s) is(are) added to the bulk feed material in the form of a liquid, or dissolved in a liquid. The liquid material is preferably placed in a container which can be closed while liquid is added to the container/feed material prior to the treatment, such that the under-pressure is subjected to the feed material while this is in the liquid, and in particular that the whole of the container is full of the mixture of feed material and liquid, i.e. there is no air present in the container when the under-pressure/vacuum is applied.

There is a considerable advantage in the pellets being in excess of liquid so that it is only the air inside the pellet that is to be removed by the vacuum. The advantage of this is that the time under vacuum is very short. This will prevent the oil (when the liquid is an oil) boiling and evaporating. If one lets the oil boil it will condense when the pressure is increased back to atmospheric pressure. The oil will then exist as a film on the surface and it can be sucked into the vacuum apparatus.

This problem will not be present when it is oil which shall be fed into the pellet. All the mentioned patent publications use oil in their tests. Then the problem will not be present because the oil will condense when the pressure is increased, and penetrates into the pellet,
possibly lying on the walls in the container until the next time oil is added.

According to the present invention, this is solved by applying a vacuum for a short time, for example for 1 second, and a container which is completely filled with liquid and feed pellets, and where the excess liquid can be recycled.

The liquid itself can be fresh water or salt-containing water which one wishes to add to the feed material, as the water can contain vitamins, medicines, minerals and the like in a completely or partially dissolved form in the liquid.

Consequently, provided by the invention is a new method that can be used to optimise the fish feed with respect to water content immediately before the feed is given to the fish. This also ensures that the fish feed does not float when it is fed to the fish.

According to the invention, the container is at first filled with the desired amount of fish feed and thereafter completely filled with water. It is important that the container is filled completely with feed material and topped up with water so that no air remains under the lid. Thereby, it is only the air in the fish feed which is affected when the vacuum is applied.

By way of a suitable pipe connection, a tank with vacuum is then connected to the container by a valve being opened. The fish feed, which contains a certain fraction of air, is then subjected to a vacuum and the air disappears out of the fish feed. The container is thereafter subjected to normal atmospheric pressure with the result being that the water is sucked into the pores and void spaces of the fish feed.

Thereafter, the feed can be fed directly out to the fish according to need. For this purpose the containers are opened and the treatment-water containing the fish feed can run through a pipe and out into the bulk water in a pond in which the fish are contained and fed.
The pipes through which the fish feed runs will also contribute to a careful treatment of the feed so that the feed is largely without cracks and breaks (disintegration) when it flows out into the pond water to the fish.

Consequently, an extra fraction of water has been added to the fish feed, with the added amount of water depending on the specific gravity of the fish feed and the strength of vacuum used.

Feed material to which more fresh water has been added through the invented method, results in a great advantage for seawater fish. This leads to the fish not having to «drink» so much seawater. When the fish drinks seawater it has to get rid of an excess of salt ions, something that results in an unnecessary expenditure of energy for the fish. The fish can use this energy on growth instead, and it will consequently make better use of the feed material. This will yield an increased growth per unit amount of feed material.

Alternatively, seawater can be added to the feed material, something that is well suited, for example, when salmon smolt shall be prepared for transfer to seawater. The smolt will then be gradually exposed to increasing amount/concentration of salt in the water and gradually be adapted to life in seawater. In this application of the invention, one does not need to buy special feed materials which contain extra salt.

According to yet another embodiment of the invention, the water, which shall be forced into the pellet, is supplemented with vitamins, medicines, salts, minerals or other substances that the fish need. When the supplementary substances are dissolved in the water that is conducted to the container, it will be fed into the feed pellet which is subsequently eaten by the fish. In this way, one will be able to supply to the fish an optimal feed material that will lead to an improved growth and health.

With this embodiment, in which it is desirable to add supplementary substances to the feed, it can, in certain circumstances, be necessary to use some extra equipment
such as a separate container wherein the supplementary ingredients are added and mixed with or dissolved in the water. After the feed has been added to the water-supplementary ingredients, the excess water can be pumped back to an additional container. This water already contains the supplementary ingredients and can be returned to the main container later on.

It is also possible to conduct the feed material through the device without the mentioned water addition. Then the feed material is conducted straight from the silo, or sack through hatch 1 and straight into the container. The container will be filled with water and the mixture of fish feed and water will flow to the feeding location.

It is also possible to use a pump instead of the height difference to deliver the water to the feeding location. It will be advantageous if there is a natural drop on the transport pipes all the way to the pond.

Another previous problem is also solved by the invention. The feed producers often struggle with the feed material floating, and in particular the small pellet sizes. This is often caused by a combination of relatively high seawater temperature and relatively low feed material temperature. What happens when the feed material is thrown out onto the sea is that it gets heated by the seawater?

This leads to the air which exists inside the pores in the pellet itself expanding (cf. the ratio between the temperature and volume of a gas) and can lead to the formation of a thin layer of air lying around the fish feed material. This can result in the feed material floating. If the water which is to transport the feed material is relatively cold (brought up from deep waters) in relation to the temperature of the feed material, it is possible to reduce this problem.

The feed manufacturers will also have free hands to manufacture feed material with a lot of binding agent such as, for example, wheat. Wheat gives a much stronger pellet, but it can lead to it being inflated during extrusion, and thereby floating. With the new device, an inflated pellet
may contain more fat per unit weight. This leads to the feed manufacturers being able to produce feed with a higher fat content without the fish feed material losing fat during storage. Without the new device, this feed material would float and be useless. If the feed material is conducted through the device according to the invention, the feed material will sink.

The invention will now be described in more detail with reference to the enclosed drawing that shows a device according to the invention to carry out the method.

The figure shows a housing-forming container 26 that is used in the treatment of the feed material (pellets or precursors of the pellets).

The container 26 can be closed at the top by means of a lid 1 and at the bottom by means of a hatch/grating 24 that comprises a plate perforated with holes through which water can flow. The feed material cannot pass through the holes. The container comprises a level-switch at 4. Pipes lead into the container 26 (from above) as follows:

- A pipe 30 including a stop valve 3 connecting it to a vacuum source, such as a vacuum tank.
- A pipe 40 with a one-way valve to prevent over-pressure in the container 26. Situated in the top of the container.
- A pipe 50 including a stop valve 5 adjustable throttle valve 6 is used to let air into the container.
- Pipe 60 with inserted stop valve 2 is for supply of water.
- Pipe 65 connects the tank 26 with an intermediate tank 22 which can contain water with supplementary ingredients. The tank 22 is pipe connected to a main supply 23, with a valve 19 being included in the pipe.
- Pipe 70 with connected pump 16 is connected to the tank 22. The pump 16 is used to draw the water that is not pulled into the pellet in the container 26 back to the tank 22. Valve 15 closes the pipe 70 that in addition leads into channel 8. Thereafter, the next batch of feed material that is to be treated with water with supplementary ingredients can be added. In the channel 80, there is also arranged, in
this connection, a level switch 21. From the intermediate tank 22 with water additions, it is possible to return water with supplementary ingredients to the container 25. This is carried out at the next batch which is to be treated. The valve (18) is then opened.

- A main channel 80 to conduct water and feed material to the feeding location is marked with 80 and a tank for supply of feed material which may not be treated, is shown at 25. This tank can be made to release feed into the channel. The channel 80 includes valves upstream 13 and downstream 7 of the treatment container 26, and downstream by 8 for the feed tank. Furthermore, there is a throttle valve 14 upstream of the valve 13 which can open for water that shall contribute to lead the feed material to the feeding location. When evacuation is commenced, the volume which is to be evacuated is defined by the container 26 and the part of the channel 80 which is positioned between the valves 7 and 13.

Valve 7 is arranged to open and close the connection between the container and the feed tank. The valve 8 may open and close connection to the feeding pipe that shall transport feed material to the fish. The valve 12 is used to open for the supply of the water that shall transport the feed material to the fish. The feed tank 26 contributes to regulate the liquid column, and thus the speed at which the feed material is fed through the pipes to the fish. The level switches 9, 10 and 11 are used to regulate the level in the feed tank 26 and container 25.

Besides, the system can preferably be equipped with additional equipment which can be used if vitamins, minerals, colouring substances or other supplementary ingredients shall be added to the feed material. These are installed if it is not desirable that the water with supplementary ingredients, which are not pulled into the feed material, are discharged straight into the sea.

The container 26 is also, when the hatch/grating 24 is opened, arranged to let treated feed material down into the channel 80 to be brought to the feeding location.
The feeding installation outlined can be controlled with both manual and automatic control. The manual control will consist of either manual or electrically controlled valves. The automatic control will be PLC (programmable logic control), controlled with the possibility for running all operations from a computer (PC). Electrical and electrically controlled pneumatic valves will be possible. It will also be possible to build in options for logging and storing of data regarding the feeding process. Parameters such as amount of feed material, time of feeding, water temperature, light conditions are parameters which will be of interest.

It is also possible to integrate existing or new systems for optimising the feeding operation. An example of this can be a device that registers when the fish finish eating the feed, something which leads to the feeding operation being automatically stopped.

How the device (method) according to the invention can be operated shall be described in the following, while all the time referring to the figure.

Valves 15, 18, 19 and level switch 21 are used. Pump 21, intermediate tank with water additions 22 and main tank with water additions 23 are equipment which are only used if water with supplementary ingredients is to be added. This can be for environmental or cost considerations. The pump 16 feeds the water which is not being sucked into the pellet, back to the tank 22. Then it can be added to the next batch with feed material which then is treated with water with supplementary ingredients.

Status before the treatment starts.

The feed tank 25 and the container 26 are initially filled with water to a level that is marked on the figure by the level switch 9. The valves 2, 3, 5, 7, 8, 12, 13, 15 and 18 in addition to the container 26, are closed. The lower closing hatch/grating 24 is open and hatch (1) is open.
Treatment starts.

The sequences in the treatment of the feed material can, according to an example, be as follows: Feed material is conducted into the container 26 through the closing hatch 1. The valve 2 is opened and water is supplied until the level switch 4 is triggered and closes the water supply. The container is now completely full. The closing hatch 1 is closed and the valve 3 is opened. Then a connection to the vacuum tank is established and the container is subjected to an under-pressure (vacuum), and air will then be sucked out of the feed material. The air will rise to the surface in the container. The valve 5 is opened and is regulated with the throttle valve 6. The valve 7 is opened. Due to the adjustable throttling of the air in the throttling valve 6, the feed material will flow from the container to the feed tank 25 at a slow speed. The valve 8 is opened and the feed material flows in the pipe to the feeding location. The levels in container and feed tank decide the rate of flow of the feed material through the pipe to the feeding location. This can be controlled by the level switches 9 and 10 and the supply of water through the valve 2. Extra water can be supplied through valve 13 and be regulated with the throttle valve.

After all the feed material has left the feed tank and container, valve 8 is closed. Water to conduct the feed material down to the feeding location is fed into the feeding pipe 80 through the valve 12. Valve 2 is opened and water is filled into the container and feed tank until the level switch 9 is triggered and closes the supply. The valve 7 is closed.

Supply of feed material which is not supplied extra water. The valves 7, 8, 13 and 2 are opened. Water flows in. Pre-weighed amounts of feed material are added through hatch 1. The feed material hits the water and is conducted out of the container through the hatch 24 and further through the channel 80 to the feeding location.
Addition of vitamins, medicines, salts, minerals or other substances to the feed.

In this instance, the valves 15, 18, 19 are operated and level switch 21, pump 16, intermediate tank with water supplements 22 and main tank with water supplements 23 are installed.

Feed material is fed into the container 26 whereupon the valve 18 is opened. Water from the intermediate tank with water supplements 22 is fed into the container 26 until the level switch 4 is triggered. If the intermediate tank 22 is empty before level switch 4 is triggered, the valve 19 must be opened and water from the main tank 23 will flow in until the level switch 4 is triggered. The valves 18 and 19 can then be closed. The hatch 1 is closed and the valve 3 is opened and air will then be sucked out of the feed material. The air will rise to the surface in the container. Valve 5 is opened and is regulated open with throttle valve 6. The valve 15 is opened and pump 16 is started. When the level switch 21 is triggered, the pump 16 can be stopped and the valve 15 closed. Valve 13 is now opened and the container is filled until the level switch 4 is triggered. Then the hatch/grating is opened.

The valve 7 is opened. By regulating the throttling of air in the valve 6, the feed material will slowly flow from the container and to the feed tank. The valve 8 is opened and the feed material flows through the pipe to the feeding location. The levels in the container and the feed tank decide the speed of the feed material through the pipe to the feeding location. This is controlled by the level switches 9 and 10 as well as the supply of water through valve 2. Additional water can be supplied through valve 13 and be regulated with the throttle valve. After all the feed has left the feed tank and container, the valve 8 is closed. Water which shall take the feed material down to the feeding location comes in through valve 12. The valve 2 is opened and water flows into the container and feed tank.
to the level switch 9. Thereafter the valve 7 is closed and the hatch/grating 24 is closed.

The abovementioned example represents only a preferred method of operating the treatment installation according to the invention. The individual actions can be carried out in other ways to achieve the same results.

By using the method and device according to the invention, water can be added to fish feed in a new and more simple way, with a possible addition of vitamins, minerals, colouring substances or other supplementary ingredients immediately before feeding takes place.

The feed material is weighed into a container. In the container, the mixture of fish feed and water, with possible additions, are subjected to a vacuum. Air inside the feed will be sucked out of the feed material. The mixture will subsequently be exposed to atmospheric pressure and water with supplementary ingredients will be absorbed into the feed material.

The transport from the appliance above to the feeding location will take place in a pipe. The feed material will then lie in water and flows to the feeding location either by the aid of gravity or by the water being pumped. This gives a gentle transport of the feed material from where the device is located and to the feeding location.

By the invention one achieves the great advantage that the fish farmer can order a standard feed material, and immediately prior to the feeding he can decide how much colouring material, vitamins, minerals or medicines the fish need. Consequently, he does not have to decide on such ingredients when ordering the feed from the supplier. It is known that colouring substances, such as astaxanthine oxidises during manufacturing of the feed. With the present invention, one can almost eliminate this problem with substances which degrade between manufacture and use, in that the colouring substances can be stored under optimal non-degrading conditions (prevent oxidation), to be added to the feed by the method according to the invention whereby it is given directly to the fish. Colouring
substances and vitamins can account for up to 25% of the cost of the fish feed.

Thus, the method according to the invention represents a great step forward in this subject area.
Claims

1. Method for treatment of feed materials of a pellet shape, or clump or sheet shaped precursor materials for such feed materials, which shall be given to an organism, where a volume of the feed material in a container, for the supply of necessary supplementary substances to the feed material, is subjected to an under-pressure over a given time period, for venting of gases/air in the pores/void spaces of the feed material, whereupon the container is subjected to a higher pressure than atmospheric pressure whereby the necessary supplementary substances are forced into the void spaces and pores of the feed material, characterised in that the supplementary substances, in the form of a liquid, or dissolved or suspended in the liquid, are supplied to the container/feed material before the treatment, so that the feed material is subjected to the under-pressure while it is in excess liquid.

2. Method according to claim 1, characterised in that the container is completely filled with liquid/feed material when the under-pressure is applied.

3. Method according to claim 1-2, characterised in that the liquid/feed material is subjected to an under-pressure in the form of a vacuum over a given time period of about 1 second before the pressure is increased again.

4. Method according to any of the claims 1-3, characterised in that the desirable supplementary substance(s) is(are) added to the feed material volume in the form of a liquid, or completely or partially dissolved in the liquid.

5. Method according to any of the claims 1-4, characterised in that the applied liquid is fatty material, oil, fresh water or saline water which is desirable to add to the feed material.
6. Method according to any of the preceding claims, characterised in that the applied liquid contains vitamins, medicines, colouring substances, minerals and the like in dissolved form in the liquid.

7. Method according to any of the preceding claims, characterised in that after the treatment, the mixture of liquid and feed material is delivered through a channel (80) directly to the feeding process.

8. Method according to any of the preceding claims, characterised in that after the treatment, the mixture of liquid and feed material is stored in an intermediate storage tank (25) prior to delivery as feed.

9. Method according to any of the preceding claims, characterised in that after the treatment the excess liquid is recovered and used again.

10. Application of the method according to claims 1-9, for manufacture of feed pellets that shall be given to an organism, in particular fish, which are kept in a pond.

11. Application of the method according to the preceding claims, in which the method is incorporated into a feeding installation for fish.

12. Application of the method according to the preceding claims for treatment of feed materials in pellet form, or of clump or sheet formed starting materials for such feed materials, which shall be given to an organism which is kept in a pond, where a volume of the feed material in a container, for supply of necessary supplementary substances to the feed material, the container is subjected to an under-pressure over a given time period, for venting of gases/air in the pores/void spaces of the feed material, after which the volume is subjected to a higher pressure.
than atmospheric pressure whereupon the necessary supplementary substances are forced into the void spaces and pores of the feed material, with the method being incorporated as a part of the procedure for a feeding installation for fish, so that treated feed is immediately fed to the pond and used by the fish.