

SPECIFICATION

METHOD FOR TREATMENT OF OIL-AND-FAT-CONTAINING WASTE WATER USING YEAST, AND NOVEL YEAST

TECHNICAL FIELD

[0001] The present invention relates to a method for treating oils and fats and a yeast-bearing carrier in grease traps and waste water decomposition treatment tanks.

Furthermore, the present invention relates to a novel yeast and a method for treating oils and fats using said yeast.

BACKGROUND ART

[0002] In conventional decomposition treatments such as surface aeration, scum having a high oil content does not easily decompose, and is thus collected as floating scum to be separately discarded. In the grease traps provided in restaurant kitchens as well, the scum having a high oil content rises and accumulates at the top, where it can give off foul odors and must be periodically separated to be discarded.

[0003] Additionally, there have been proposals for promoting decomposition of oils and fats in grease traps by means of microbes (Patent Document 1). However, microbes have difficulty performing well in the special environment of a grease trap, and even if oil/fat-decomposing microbes are introduced, most of them will be gradually drained away together with waste water, before their effects are fully realized.

Patent Document 1: Japanese Patent Application, First (*kokai*) Publication No. 2004-188405

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

[0004] Thus, the present invention has the purpose of offering a method and microbe-bearing carrier capable of reducing the outflow of microbes from grease traps and waste water decomposition treatment tanks, promoting the proliferation of microbes

and efficiently decomposing oils and fats by means of microbes.

Furthermore, the present invention has the purpose of offering a novel yeast having a high oil/fat decomposing ability.

Additionally, the present invention has the purpose of using the novel yeast having a high oil/fat-decomposing ability to decompose oils and fats, and treat the oils and fats in grease traps and waste water decomposition treatment tanks.

Means for Solving the Problems

[0005] Therefore, the present invention offers a method of decomposing oils and fats in a grease trap or waste water decomposition treatment tank by means of a yeast, by introducing a porous carrier having a specific gravity of 1 or less with respect to water and a yeast having a high oil/fat decomposing ability to waste water in the grease trap or waste water decomposition treatment tank. The yeast in the present method is *Pichia farinosa*.

Furthermore, the present invention offers a porous carrier for decomposing the oils and fats in a grease trap or waste water decomposition treatment tank. The porous carrier of the present invention is a carrier comprising a carrier body having a specific gravity of 1 or less with respect to water and bearing a yeast having a high oil/fat decomposing ability.

[0006] In the present invention, the carrier floats near the surface of the water. Preferably, at least half the carrier will be underwater, and more preferably at least 90% will be underwater. Since oils and fats tend to collect at the top on the surface of water, such a carrier will be capable of efficiently bringing the yeast into contact with oils and fats. Furthermore, the yeast will be able to more easily obtain oxygen. Furthermore, since the waste water outlet of a grease trap is at the bottom of the container, the outflow of carriers can be prevented by allowing them to float near the surface, while also making it easier to collect the carriers.

In the present invention, the oils and fats in waste water are preferably decomposed aerobically.

A tank to which yeast has been added can also be aerated. Furthermore, the waste water containing oils and fats in the tank can be emulsified by adding enzymes from a yeast to the tank.

The method of decomposing oils and fats by means of a yeast according to the

present invention has the advantage of not generating foul odors.

[0007] Examples of porous carrier bodies include zeolites, sponges, paper and cotton fabric. In the present invention, it is preferable to use an oil-absorbent sponge, more preferably a synthetic sponge, especially a polyurethane sponge.

The porous carrier used in the present invention, in waste water containing oils and fats, adsorbs waste water, particularly oils and fats, at the carrier surface, preferably absorbs them into the carrier, and thereby plays the role of carrier or culture for microbes that feed on the oils and fats.

Therefore, the carrier material has a large number of holes, is non-oil-repellant and oil-absorbent (meaning here the property that it does not repel oils and fats, and absorbs oils in porous cavities), and preferably has a specific gravity that will not exceed 1 and therefore will not sink even after absorbing water or oils. In particular, it must be held in a state of floating in a grease trap or waste water decomposition treatment tank for a long period of time. With such a porous carrier, the pores will absorb oils and the oils will be decomposed by the yeasts collected in the carrier. Additionally, if the grease trap or waste water decomposition treatment tank is aerated, then gases will adhere to the surface of the carrier, thus having the effect of improving proliferation and activity of aerobic microbes. Furthermore, the porous carrier should preferably be capable of absorbing water. This is because microbes are more easily adsorbed by capillary action.

[0008] On the other hand, for light carriers with a very low specific gravity such as foamed styrol, most of the volume of the carrier will float above the surface of the water, while carriers such as cellulose will sink, so these are not preferable for use in the present invention. With materials such as the cotton used to adsorb marine oil spills, the fibers can come loose and separate, in which case they will easily flow out of the tank. Furthermore, with carriers that are not oil-absorbent, yeasts having the ability to decompose oils and fats will not proliferate in the carrier.

The porous carrier of the present invention holds the yeast and other coexisting oil/fat-decomposing microbes while providing a buffer against sudden changes such as in acidity and temperature due to the influx of waste water. As such, the porous carrier should be of a size enabling the yeast to be protected from the environment outside the carrier, while allowing the oils and fats to reach the yeast inside the carrier, and can, for example, be a cube or sphere with sides or diameter of at least 1 cm and less than 5 cm.

In order to prevent the death of the yeast, it is necessary to maintain the environment for growing the yeast at less than 60 °C. Therefore, in the case of grease traps or waste water decomposition treatment tanks which have a small tank size and tend to reach very high temperatures, it is possible to provide an external tank (detour tank) suitable for growth of yeast, and to perform the oil/fat-decomposing treatment by the yeast there.

Additionally, the porous carrier of the present invention also has the effects of forming a film of oils and fats near the surface, to further dampen changes such as temperature increases.

[0009] In the method of the present invention, the carrier body can be added implanting the yeast, or the carrier body and yeast can be separately added to the tank, then the yeast allowed to grow in the carrier later. Preferably, the porous material is impregnated with an oil, sterilized at a high temperature, then implanted with the yeast. After impregnating the porous material with oil, it can be further impregnated with a yeast extract (such as shochu effluents). When a porous carrier to which a yeast having a high oil/fat-decomposing ability has been adhered and grown is allowed to float in a grease trap or waste water decomposition treatment tank for a long time, other oil-eating microbes will proliferate inside or on the surface of the porous carrier, so that the decomposition of oils and fats will be synergistically promoted by the yeast and other oil/fat-decomposing microbes.

In the method of the present invention, the yeast and microbes which have proliferated will also flow into and adhere to the water drainage pipes and decompose scum, thus providing the additional advantage of eliminating scum adhering to drainage pipes downstream.

In the present method, it is even more preferable to add a yeast culture solution to the grease trap or waste water decomposition treatment tank together with the yeast-bearing carrier. The yeast culture solution aids in immediately eliminating foul odors by means of enzymes from the yeast.

[0010] Additionally, the present invention offers a novel yeast having a high oil/fat-decomposing ability.

The yeast of the present invention is particularly a yeast deposited at the NITE Patent Microorganisms Depositary under accession number NITE BP-287 on November 30, 2006. This yeast belongs to the genus *Pichia*, and is believed to belong specifically to

the species *Pichia farinosa*, having a high oil-decomposing ability, and capable of growing in a culture having not carbon sources other than oils and fats, in other words having only oils and fats as a carbon source.

The novel yeast offered by the present invention particularly has the ability to decompose oils and fats aerobically, and furthermore, this yeast is capable of decomposing and feeding on animal oils and fats. Additionally, it has the exceptional property of having an extremely fast oil/fat-decomposition rate as compared with other strains of *Pichia farinosa*. When the present yeast is used for decomposition of oils and fats in a grease trap or a waste water decomposition treatment tank, it promotes proliferation of other microbes useful for decomposition of waste water, while preventing proliferation of harmful microbes that generate clumps.

[0011] When considering the temperature, content and flow rate of waste water flowing into the grease trap or waste water decomposition treatment tank, the microbe used for decomposition treatment must also have adaptability and resistance to this environment. Additionally, the microbe should preferably not generate foul odors during the treatment. The novel yeast offered by the present invention is suitable for treatments in grease traps and waste water decomposition treatment tanks, having not only a high oil/fat-decomposing ability but also adaptability and resistance to extraordinary environments (e.g., high or low water temperature, and high or low pH), not generating foul odors during decomposition treatment, and being safe for humans.

The yeast of the present invention also has the advantage of staying inside the porous carrier even in environments with flow such as grease traps, thus enabling the treatment to last for a long time.

Furthermore, the introduction of the present yeast also has a deodorant effect, removing foul odors from grease traps and waste water decomposition treatment tanks.

[0012] The present invention offers an oil-containing waste water treatment agent comprising a yeast having a high oil/fat-decomposing ability, and a oil-containing waste water treatment carrier comprising a carrier bearing the yeast.

Furthermore, the present invention offers a method of decomposing oils and fats using a yeast having a high oil/fat-decomposing ability, and a method of treating oils and fats with the yeast by introducing the yeast to a grease trap or waste water decomposition treatment tank.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0013] [Fig. 1] Fig. 1 shows a waste water decomposition treatment tank.
- [Fig. 2] Fig. 2 shows a waste water decomposition treatment tank in a method according to the present invention.
- [Fig. 3] Fig. 3 is a photograph depicting a yeast culture according to the present invention.
- [Fig. 4] Fig. 4 is a scanning electron microscope photograph of the yeast according to the present invention.
- [Fig. 5] Fig. 5 shows the identity between the yeast according to the present invention and strains considered to be closely related.
- [Fig. 6] Fig. 6 shows a phylogenetic tree of the yeast according to the present invention and closely related strains constructed by a neighbor joining method.
- [Fig. 7] Fig. 7 shows the oil-decomposing ability of the yeast according to the present invention in a 30 °C culture.
- [Fig. 8] Fig. 8 shows the oil-decomposing ability of the yeast according to the present invention in a 37 °C culture.
- [Fig. 9] Fig. 9 shows the waste water decomposition treatment tank used in Example 1.
- [Fig. 10] Fig. 10 is a photograph depicting a grease trap before adding (A) and 24 hours after adding (B) the yeast according to the present invention.
- [Fig. 11] Fig. 11 is a photograph showing the results of Example 3.
- [Fig. 12] Fig. 12 shows the results of Example 6 in a graph.
- [Fig. 13] Fig. 13 shows the results of Example 7 in a graph.
- [Fig. 14] Fig. 14 shows the results of Example 8 in a graph.

BEST MODES FOR CARRYING OUT THE INVENTION

- [0014] Herebelow, preferred modes for carrying out the present invention shall be explained.

Normally, in the grease traps at restaurants and the like, scum containing large amounts of oils is lighter than water and thus has the property of rising, so as shown in Fig. 1, partitions are installed on the drainage path such as to allow outflow from the bottom, and here the scum is allowed to float to the top and separated.

In a preferred embodiment of the present invention, a yeast is anchored in a substance that is porous like a sponge and has a lower specific gravity than water, and this is placed in the grease trap or waste water decomposition treatment tank as shown in Fig. 2.

Additionally, the grease trap or waste water decomposition treatment tank can be aerated.

[0015] The novel yeast of the present invention is deposited at the NITE Patent Microorganisms Depositary (NPMD) under Accession No. NITE BP-287. This yeast is believed to be a new strain of *Pichia farinosa*. Furthermore, the yeast offered by the present invention has a high oil-decomposing ability.

[0016] The novel yeast NITE BP-287 of the present invention has the following taxonomical properties.

1. Cultural/morphological properties

Fig. 3 shows a photograph of the results after culturing the present yeast in an MY culture (40 ml) for two days at 30 °C is shown in Fig. 3.

Bacto yeast extract	0.12 g
Wheat germ extract	0.12 g
Tryptone peptone	0.2 g
Glucose	0.4 g
Agar	0.6 g

Additionally, Fig. 4 shows a photograph of the morphology of the present yeast as seen under a scanning electron microscope.

[0017] 2. Physiological/chemotaxonomical properties

The full-length based sequence of the 18S rDNA of the present yeast was as shown in SEQ ID NO:1.

Fig. 5 shows the identity between the present yeast and strains considered to be closely related.

Fig. 6 shows a phylogenetic tree of the yeast according to the present invention and closely related strains constructed by a neighbor joining method. As a result, the present yeast is predicted to be *Pichia farinosa*.

[0018] 3. Oil-decomposing ability of present yeast

The present yeast was cultured by adding a 10% salad oil solution to an MY

culture and aerating for 20 hours at 30 °C and aerating for 20 hours at 37 °C. These cultures were centrifuged, and their supernatants were analyzed by thin layer chromatography. Figs. 7 and 8 show the results, which indicate the oil-decomposing ability. The results show that the present yeast decomposed much of the oil from the salad oil in the 30 °C culture, and almost all of the oil in the 37 °C culture.

[0019] The method for treating oils and fats according to the novel yeast of the present invention is performed by adding the above-described yeast to waste water in an object of treatment, for example the waste water in a grease trap or a waste water decomposition treatment tank. Preferably, a porous carrier is added together with the yeast. The yeast can be held by the carrier so as to reduce the frequency of addition, and oils can be adsorbed by the carrier so as to accelerate the decomposition of oils by the yeast.

The agent for treating oil-containing waste water according to the present invention includes the novel yeast described above, and in some cases, a carrier.

The carrier for treating oil-containing waste water according to the present invention is a carrier holding the novel yeast described above, and is preferably a porous material, such as a sponge, zeolite or paper.

Example 1

[0020] Decomposition of floating scum in grease trap or waste water treatment tank 1

A yeast (the yeast of Accession No. NITE BP-287 deposited at the NITE Patent Microorganisms Depository (NPMD) on November 30, 2006) was anchored to a sponge 1 cm on a side, which was porous and had a specific gravity lighter than water, as shown in Fig. 9. As a result, scum was able to be continuously decomposed in this treatment tank without allowing it to rise to the top over a long period of time.

Photograph A of Fig. 10 shows a grease trap before adding the anchored yeast. The oily scum has risen to the top. Photograph B shows the grease trap after adding the yeast anchored to the sponge exposing to air for 24 hours. It is possible to observe that the scum has been satisfactorily decomposed.

During the treatment, hot water of 60 °C or more and detergents were fed, but the air layer adhering to the carrier surface protected the microorganisms in the sponge.

Example 2

[0021] Decomposition of floating scum in grease trap or waste water treatment tank 2

A yeast of the NITE BP-287 strain was anchored to polyurethane sponges 2 cm on a side, which were introduced as shown in Fig. 9. The normal hexane value was reduced, no clumps of bacteria were formed, and other microbes useful for decomposing waste water proliferated.

Example 3

[0022] A bottle (A) filled with oil-containing water was prepared, and air was delivered using a tube. Separately, another bottle (B) containing a sponge and filled with oil-containing water was prepared, and air was delivered using a tube.

As a result, the oil in bottle (A) became separated at the top (Fig. 11A), whereas in bottle (B), the oil was adsorbed by the sponge (Fig. 11B).

Consequently, it was found that oils can be collected in a sponge bearing large quantities of oil-decomposing microbes, and thus oils can be efficiently decomposed using the method of the present invention.

Example 4

[0023] Comparison of Sponge Material

The sponges that are generally available are composed of materials such as polyurethane, polyethylene and melamine. We considered the sponge material most suitable as a carrier in grease trap treatments of *Pichia farinosa*.

[0024] Experimental Results

Polyethylene, melamine and polyurethane were placed in a container filled with water and salad oil, to observe the adsorption of the salad oil by the sponge materials. The results were as follows.

1. Polyethylene

Some oil was adsorbed, but not all of it was able to be absorbed, leaving some floating on the surface.

2. Melamine

Oil was not adsorbed, and was left floating on the surface.

3. Polyurethane

Oil was absorbed by the entire sponge, and no oil drops were observed on the surface.

[0025] We found that polyurethane best adsorbs salad oil in water containing salad oil. Therefore, polyurethane seems to be the optimum carrier for *Pichia farinosa* in grease trap

treatment.

Example 5

[0026] Measurement of Normal Hexane Values in Grease Trap 1

The normal hexane value in a grease trap decreased from 30,000 ppm to 24,000 ppm after introducing sponges, and was reduced to less than 10,000 ppm after introducing yeast.

Example 6

[0027] Measurement of Normal Hexane Values in Grease Trap 2

A treatment in a grease trap was continued for one month under the conditions indicated below, and the normal hexane value in the tank was measured each morning. The normal hexane value in an untreated grease trap was about 9000 ppm.

1. Introduction of sponges planted with *Pichia farinosa* and aeration.
2. Introduction of sponges and aeration.
3. Aeration only.

The average values of the measured normal hexane value for one month are shown in Fig. 12. The graph shows that the oils and fats are very efficiently treated by the method of the present invention.

Example 7

[0028] Comparison of Growth of *Pichia farinosa* of Different Origins in Cultures of Oils/Fats and Inorganic Salts Only

Experimental Procedure

A culture consisting of oils/fats and inorganic salts was inoculated with *Pichia farinosa* from a slant, and shake-cultured for three days at 37 °C.

The culture was diluted, used to inoculate an MY culture, and the number of yeasts was measured.

[0029] Table 1: Comparison of Number of Yeasts by *Pichia farinosa* Origin

	Number of yeasts (cfu/g)
NITE BP-287	2.01×10^7
from Tokyo University of Agriculture	2.11×10^5
JCM2986	4.68×10^6
JCM8895	2.41×10^5
JCM10734	1.61×10^5

[0030] The results are shown in a graph (Fig. 13).

NITE BP-287 grew well in a culture of only oils and fats and inorganic salts.

This suggests that this strain is capable of decomposing oils and fats and using them as a source of energy.

Example 8

[0031] Comparison of Heat Resistance of *Pichia farinosa* from Tokyo University of Agriculture and NITE BP-287

The temperature of the waste water flowing into the grease traps in restaurant kitchens is not constant, and at times, water that is close to boiling will enter. When treating such grease traps with microbes, it is important to consider whether or not the microbes are capable of withstanding high temperatures. Therefore, we tested and compared the heat resistance of the novel yeast of the present invention with the strain from the Tokyo University of Agriculture.

[0032] Experimental Procedure

Pichia farinosa was shake-cultured for two days at 37 °C using a culture of shochu lees. The culture solution was injected into separate test tubes, which were kept for 30 minutes in isothermic tanks set to 60 °C, 70 °C and 80 °C, and the number of yeasts was compared to that before heating. The measurement of the number of yeasts was performed by step-dilution with a 0.9% sodium chloride solution, followed by cultivation in an MY culture.

Experimental Results

The yeast survival rates are shown in the following table and a graph (Fig. 14).

[0033] Table 2: Survival Rate of *Pichia farinosa* after Heat Treatment

	Tokyo University of Agriculture	NITE BP-287
Before heating	100.000	100.000
30 minutes at 60 °C	0.009	0.027
30 minutes at 70 °C	0.000	0.000
30 minutes at 80 °C	0.000	0.000

The survival rate was better for NITE BP-287 in the case of heating for 30 minutes at 60 °C. There is a possibility that the yeast of the present invention can grow more dominantly than other strains in a grease trap.

CLAIMS

- [1] A method of decomposing oils and fats in a grease trap or waste water decomposition treatment tank by means of a yeast, by introducing a porous carrier having a specific gravity of 1 or less with respect to water and a yeast having a high oil/fat decomposing ability to waste water in the grease trap or waste water decomposition treatment tank, wherein the yeast is *Pichia farinosa*.

- [2] A method in accordance with claim 1, wherein the specific gravity of the porous carrier with respect to water is less than 1.

- [3] A method in accordance with claim 1 or 2, wherein the porous carrier is chosen from among zeolites, sponges, paper and cotton fabric.

- [4] A method in accordance with any one of claims 1 to 3, wherein the yeast can grow in a culture containing only oils and fats as carbon sources.

- [5] A method in accordance with claim 4, wherein the yeast is NITE BP-287.

- [6] A carrier for decomposing oils and fats in a grease trap or waste water decomposition treatment tank, comprising a carrier body having a specific gravity of 1 or less with respect to water and bearing a yeast having a high oil/fat decomposing ability.

- [7] A carrier in accordance with claim 6, wherein the porous carrier has a specific gravity with respect to water of less than 1.

- [8] A carrier in accordance with claim 6 or 7, wherein the porous carrier is chosen from among zeolites, sponges, paper and cotton fabric.

- [9] A carrier in accordance with any one of claims 6 to 8, wherein the yeast is capable of growing in a culture containing only oils and fats as carbon sources.

- [10] A carrier in accordance with claim 9, wherein the yeast is NITE BP-287.

- [11] A yeast of the strain *Pichia farinosa* NITE BP-287.
- [12] A method of decomposing oils and fats using the yeast of claim 11.
- [13] A method of treating oils and fats by the yeast of claim 11 by introducing said yeast to a grease trap or a waste water decomposition treatment tank.
- [14] An oil-containing waste water treating agent comprising the yeast of claim 11.
- [15] An oil-containing waste water treating carrier bearing the yeast of claim 11 on a carrier.

CLAIMS

[Received by International Bureau on 30 May 2008]

[1] (amended)

A method of decomposing oils and fats in a grease trap or waste water decomposition treatment tank by means of a yeast, by introducing a porous carrier having a specific gravity of 1 or less with respect to water and a yeast to waste water in the grease trap or waste water decomposition treatment tank, wherein the yeast is *Pichia farinosa* of the strain NITE BP-287.

[2] (amended)

A method in accordance with claim 1, wherein the specific gravity of the porous carrier with respect to water is less than 1.

[3] (amended)

A method in accordance with claim 1 or 2, wherein the porous carrier is chosen from among zeolites, sponges, paper and cotton fabric.

[4] (amended)

A porous carrier for decomposing oils and fats in a grease trap or waste water decomposition treatment tank, comprising a carrier body having a specific gravity of 1 or less with respect to water and bearing a yeast, wherein the yeast is *Pichia farinosa* of the strain NITE BP-287.

[5] A carrier in accordance with claim 4, wherein the porous carrier has a specific gravity with respect to water of less than 1.

[6] A carrier in accordance with claim 4 or 5, wherein the porous carrier is chosen from among zeolites, sponges, paper and cotton fabric.

[7] A yeast of the strain *Pichia farinosa* NITE BP-287.

- [8] A method of decomposing oils and fats using the yeast of claim 7.
- [9] A method of treating oils and fats by the yeast of claim 7 by introducing said yeast to a grease trap or a waste water decomposition treatment tank.
- [10] An oil-containing waste water treating agent comprising the yeast of claim 7.
- [11] An oil-containing waste water treating carrier bearing the yeast of claim 7 on a carrier.