Liquid Fish Products

Crops

Identification of Petitioned Substance

Chemical Names:
Not Applicable

Other Names:
Fish emulsions
Fish hydrolysate
Fish soluble nutrients
Fish silage
Liquid fish protein

Trade Names:
Alaska® Fish Fertilizer
Dutch Treat Natural Fish Fertilizer
Eco-nutrients Fish Fertilizer 2-4-1
Sea Pal Liquid Fish 3-1-1
Simply Fish 2-4-0 (OMRI, 2005)

CAS Numbers:
None

Other Codes:
None

Characterization of Petitioned Substance

Composition of the Substance:

Liquid fish products include fish emulsions and fish hydrolysate (also called fish silage), each of which is described below.

Fish emulsion is the by-products of cleaned fish, such as the heads, guts and bones, cooked at temperatures in excess of 180°F to kill most of the putrefaction bacteria. The resulting product is filtered and stabilized using an acid (Baker, 1996).

There are three methods that can be used to produce fish hydrolysate. One method is to mince a whole or filleted fish. The pulp is then acidified to prevent bacterial action and mixed thoroughly so that all the fish comes into contact with acid. Using a self-digestion (autolysis) process, the mixture is liquidated. Another alternative is to add enzymes to the minced fish, causing deterioration. The oil is skimmed off, and the remains are boiled down. Phosphoric acid is added to stop the enzymes, and then potash is added to raise the pH (Julien, 1999). The third alternative is to ferment the fish and fish waste by adding a carbohydrate source, such as molasses, along with *Lactobacilli* starter culture (lactic acid producing bacteria). *Lactobacilli* convert sugar into lactic acid, which preserves the fish and creates favorable conditions for the production of silage.

For both fish emulsions and fish hydrolysates, acids are used for various reasons. While formic acid is natural, it has phytotoxic effects on plants. Currently, phosphoric acid is the preferred stabilizer (Baker, 1996). More information on the processes used to manufacture liquid fish products is provided in Evaluation Question #1.

Liquid fish products contain nutrients (e.g., nitrogen and phosphorus) useful for agriculture, as well as many trace minerals. These products also contain water, proteins, fat, and various fish biochemicals. The composition of fish products may vary depending on the type (i.e., emulsion or hydrosylate), species of fish used, and the acid used.

Properties of the Substance:
According to several Material Safety and Data Sheets (MSDSs), liquid fish products are characterized as thick brown liquids, with a strong fish smell. Other characteristics (i.e., pH, boiling point, specific gravity, etc.) tend to vary by to brand (See Table 1). According to Whiting et al. (2005), fish emulsion typically has a NPK (i.e., nitrogen/phosphorus/potassium) composition of 5-2-2. Fish hydrolysate typically has a NPK composition of 2-5-3 (Julien, 1999). These nutrient properties vary by product.

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62 **Table 1. Chemical Properties of Fish Emulsions from Select MSDSs**
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Brand	pH	Boiling Point (˚F)	Specific Gravity	Evaporation Rate (Butyl Acetate =1)	Density	Melting Point (˚F)
Alaska Fish Fertilizer[1]	3.6-3.8	---	---	---	9.25 lbs/gallon	---
Ferti-lome® Fish Emulsion Plant Food[2]	---	---	1.2	---	---	---
Gulf Menhaden Condensed Fish Solubles[3] (also known as Atlantic Menhaden; Condensed Fish Solubles; OmegaGrow™; OmegaGrow™ Plus; Refined Fish Emulsion; and Neptune™ Fish Concentrate)	3.0-4.5	220	1.17	0.8	---	---
Ortho Fish Emulsion[4]	7.0	---	---	---	---	---
Prosper Fish Emulsion[5]	7.0	212	1.14	---	---	---
Plant Booster[6]	---	<212	1.2	---	---	>32
VYSE Hydrolyzed Protein Fish Gelatin Hydrolysate[7]	5.0 - 6.5 (10% solution)	---	---	---	250 - 500 g/L	---

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[1] Source: http://www.lillymiller.com/msds/alaska/Alaska_5-1-1.pdf
[2] Source: http://v-p-g.com/MSDS/FertiLome/Water_Soluble_and_Liquid_Plant_Foods/FL%20Fish%20Emulsion%20MSDS.pdf
[3] Source: http://www.helenachemical.com/Specialty/MSDS/OmegaGrow.pdf
[4] Source: http://www2.itap.purdue.edu/MSDS/docs/9792.pdf
[5] Source: http://www.circle-one.com/downloads/fishemulsionmsds.pdf
[6] Source: http://www.organica.net/msds/MSDS%20Plant%20booster.pdf
[7] Source: http://www.vyse.com/FishGelatinHydro.htm

Specific Uses of the Substance:
Liquid fish products are used as fertilizers. Fish silage also is used as animal feed.

Approved Legal Uses of the Substance:
Liquid fish products are currently on the National List as synthetic substances allowed for use in organic crop production (7 CFR 205.601(j)(7)). No information was identified to indicate that liquid fish products are controlled by other federal regulatory programs.

Action of the Substance:
Liquid fish products are used as fertilizer because they are rich in nitrogen and are a source of several trace elements. Nitrogen is responsible for the vegetative growth of plants above ground. With a good supply, plants grow sturdily and mature rapidly, with rich, dark green foliage. Phosphorus is essential for healthy growth, strong roots, fruit and flower development, and greater resistance to disease. Potassium oxide (potash) is essential for the development of strong plants. It helps plants to resist diseases, protects them from the cold and protects during dry weather by preventing excessive water loss.

Status

International

Canada - Canadian General Standards Board - http://www.pwgsc.gc.ca/cgsb/032_310/32.310epat.pdf

Fish emulsions are permitted to amend and improve soil fertility when used in accordance with part 1.5, where applicable (CGBD, 1999).

The 2004 draft under Fish Products, Part 3 states:

"Liquid fish products can be pH-adjusted using citric or sulphuric acid. The amount of acid used cannot exceed the minimum amount needed to lower the pH to 3.5. Fish products are prohibited if they contain other synthetic preservatives or are fortified with otherwise prohibited plant nutrients."

The draft also states under Fish Emulsions and Solubles:

"Natural substances or those derived from natural substances without the addition of chemically synthesized substances or chemical treatment with the exception that liquid fish products as soil/plant amendments may be pH adjusted with citric or sulphuric acid. The amount of acid used shall notexceed the minimum needed to reach pH 3.5."

CODEX Alimentarius Commission - ftp://ftp.fao.org/docrep/fao/005/Y2772e/Y2772e.pdf

According to Table 1 of the CODEX, substances for use in soil fertilizing and conditioning, processed animal products from slaughterhouses and fish industries are allowed (provisions: need recognition from the certification body or authority).

European Economic Community (EEC) Council Regulation 2092/91 –
http://europa.eu.int/eur-lex/en/consleg/pdf/1991/en_1991R2092_do_001.pdf

Liquid fish products were not identified on this list, except as an ingredient in animal feed. Organic Trade Association confirms that liquid fish products are not allowed in the European Union (OTA, 2002).

Japan Agricultural Standard for Organic Production –
http://www.ams.usda.gov/nop/NOP/TradeIssues/JAS.html

No information was located on liquid fish products.

Evaluation Questions for Substances to be used in Organic Crop or Livestock Production

Evaluation Question #1: Is the petitioned substance formulated or manufactured by a chemical process? (From 7 U.S.C. § 6502 (21))

Yes, liquid fish products are formulated or manufactured by a chemical process due to the addition of acid. The production of fish emulsion or fish hydrolysate appears to vary between manufacturers. Generally, fish emulsion is produced by cooking the by-products of cleaned fish, such as the heads, guts and bones, at temperatures in excess of 180°F to kill most of the putrefaction bacteria (Baker, 1996). The resulting product is filtered and stabilized using an acid. When prepared in accordance with National List annotations, the acid must be sulfuric, citric, or phosphoric acid, and the amount of acid used must not exceed the minimum amount needed to lower the pH to 3.5 (7 CFR 205.601(j)(7)).

To produce fish hydrolysate, whole or filleted fish are minced. The pulp is then acidified to prevent bacterial action and mixed thoroughly so that all the fish comes into contact with acid. Liquefaction then begins, resulting from a self-digestion (autolysis) process. The rate of liquefaction depends on the type of raw material (i.e., fatty fish liquefy more quickly), its freshness (i.e., fresh fish liquefy much more quickly than stale fish), and the temperature of the process (i.e., the warmer the mixture, the faster the process). There are two alternate ways to produce fish hydrolysate. One alternative is to first add enzymes to the minced fish, causing deterioration. The oil is skimmed off, and the remains are boiled down. Phosphoric acid is added to stop the enzymes, and then potash is added to raise the pH (Julien, 1999). The second option is to ferment the fish and fish waste by adding a carbohydrate source, such as molasses, along with *Lactobacilli* starter culture (lactic acid producing bacteria). *Lactobacilli* convert sugar into lactic acid, which preserves the fish and creates favorable conditions for the production of silage. Some types of *Lactobacilli* produce other substances in addition to acid, such as antibiotics or bacteriocins, which help to limit the growth of spoilage bacteria. To obtain the optimum temperature of the fermentation process (25° to 30°C) additional heating may be required during certain times of the year (Archer, 2001). Fish hydrolysate also can be pasteurized in a dehydrator or spray-dryer to form spray-dried fish hydrolysate.

Evaluation Question #2: Is the petitioned substance formulated or manufactured by a process that chemically changes the substance extracted from naturally occurring plant, animal, or mineral sources? (From 7 U.S.C. § 6502 (21).)

Yes. Acid-treated fish is chemically different from raw fish. Fish emulsions are identified as allowed synthetic substances in the Organic Foods Production Act (OFPA) (7 U.S.C. 6517(c)(1)(B)(i)).

Evaluation Question #3: Is the petitioned substance created by naturally occurring biological processes? (From 7 U.S.C. § 6502 (21).)

No. For both fish emulsions and fish hydrolysates, the fish or fish by-products are reacted with acid.

Evaluation Question #4: Is there environmental contamination during the petitioned substance's manufacture, use, misuse, or disposal? (From 7 U.S.C. § 6518 (m) (3).)

No information was identified indicating a potential for environmental contamination from the manufacture, use, misuse, or disposal of liquid fish products.

Evaluation Question #5: Is the petitioned substance harmful to the environment? (From 7 U.S.C. § 6517 (c) (1) (A) (i) and 7 U.S.C. § 6517 (c) (2) (A) (i).)

Acids used to manufacture liquid fish products have the potential to cause harm to the environment if misused or improperly disposed. As shown in Table 1, some liquid fish products are acidic (i.e., below pH 7). For fish emulsions, too strong a solution can burn plants. Annotations to the National List specify that the amount of acid used to manufacture liquid fish products for organic crop production shall not exceed the minimum needed to lower the pH to 3.5.

Phytotoxic effects have been observed in plants that were fertilized with fish hydrolysate that used formic acid (Baker, 1996). Liquid fish products manufactured with formic acid are prohibited in organic crop production by current annotations to the National List (7 CFR 205.601(j)(7)).

Additionally, nutrients (i.e., nitrogen, phosphorous, and potassium) found in runoff from excessively or improperly applied fertilizers can cause excess algae growth in surface water (i.e., eutrophication). Excess algae can, in turn, use up oxygen in the water, potentially harming fish and other aquatic animals.

Evaluation Question #6: Is there potential for the petitioned substance to cause detrimental chemical interaction with other substances used in organic crop or livestock production? (From 7 U.S.C. § 6518 (m) (1).)

Based on the intended use of the substance, no information was identified to suggest that liquid fish products could cause detrimental chemical interaction with other substances used in organic crop production.

Evaluation Question #7: Are there adverse biological or chemical interactions in the agro-ecosystem by using the petitioned substance? (From 7 U.S.C. § 6518 (m) (5).)

If a liquid fish product is applied, without excessive runoff to surface and groundwater and the product does not exceed the minimum level of acid needed to lower the pH to 3.5, adverse biological or chemical interactions on the surrounding environment would not be expected.

Evaluation Question #8: Are there detrimental physiological effects on soil organisms, crops, or livestock by using the petitioned substance? (From 7 U.S.C. § 6518 (m) (5).)

If not applied properly, there may be detrimental effects to crops when using the liquid fish products substance. Acids used during the manufacturing of liquid fish products have the potential to burn crop plants (see Evaluation Question #5).

Available information does not indicate that use of liquid fish products is detrimental to soil organisms or livestock.

Evaluation Question #9: Is there a toxic or other adverse action of the petitioned substance or its breakdown products? (From 7 U.S.C. § 6518 (m) (2).)

Based on the intended use of the substance, no information was uncovered to suggest that use of liquid fish products (or their breakdown products) would have a toxic or other adverse action.

Evaluation Question #10: Is there undesirable persistence or concentration of the petitioned substance or its breakdown products in the environment? (From 7 U.S.C. § 6518 (m) (2).)

Based on the intended use of the substance, no information was identified to suggest that there would be undesirable persistence or concentration in the environment from use of liquid fish products (or from their breakdown products).

Evaluation Question #11: Is there any harmful effect on human health by using the petitioned substance? (From 7 U.S.C. § 6517 (c) (1) (A) (i), 7 U.S.C. § 6517 (c) (2) (A) (i)) and 7 U.S.C. § 6518 (m) (4).)

According to the MSDSs summarized in Table 1, liquid fish products may cause minor irritation, redness, and/or burning to the eyes. Prolonged exposure to the eyes may cause conjunctivitis. Dermal exposure may cause irritation, redness, and/or burning. Prolonged exposure to the skin may cause dermatitis. Ingestion of liquid fish products may cause abdominal cramps, nausea, vomiting, and/or diarrhea. Inhalation may cause upper respiratory tract irritation. Liquid fish products also may act as a mild allergen. These effects apply to handling the products before use. Once the products are applied, these effects would not be expected.

Evaluation Question #12: Is there a wholly natural product which could be substituted for the petitioned substance? (From 7 U.S.C. § 6517 (c) (1) (A) (ii).)

Manure is a wholly natural product that could be substituted for the petitioned substance. Although manure is a complete fertilizer, it lacks vital nutrients. An NPK of 1-1-1 is typical for manure (Relf, 1997), though the nutrient content of manure is dependent upon the diet and species of the animal that produced it. Fresh manure contains the highest level of nutrients needed for plant growth.

Other wholly natural products that could be substituted for liquid fish products include aquatic plant products, blood meal, bone meal, compost, feather meal, kelp meal, guano, and other nonsynthetic animal or plant products.

Evaluation Question #13: Are there other already allowed substances that could be substituted for the petitioned substance? (From 7 U.S.C. § 6518 (m) (6).)

Aquatic plant extracts – 7 CFR 205.601(j)(1) allows synthetically extracted/formulated aquatic plant extracts (other than hydrolyzed) when the extraction process is limited to the use of potassium hydroxide or sodium hydroxide.

Micronutrients – 7 CFR 205.601(j)(6) allows synthetic micronutrient product provided they are not used as defoliants, herbicides, or desiccants. Products made from nitrates or chlorides are not allowed, and soil deficiency must be documented by testing.

Evaluation Question #14: Are there alternative practices that would make the use of the petitioned substance unnecessary? (From 7 U.S.C. § 6518 (m) (6).)

The use of compost or other sources of recycled nutrients is an alternative practice that could be substitutes for the use of liquid fish products. No other alternative practices were identified.

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