Utilisation of Fish Waste by Anaerobic Digestion and Oil Extraction

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The University of Leeds has been working with Kilnsey Park Fish Farm to investigate the utilisation of fish waste and sludge, produced on the farm and the potential for conversion of the waste products into bioenergy.

Eq 1. Buswell equation

$$\frac{1}{8}(4c + h + 2o + 3n + 2s)CO_2$$

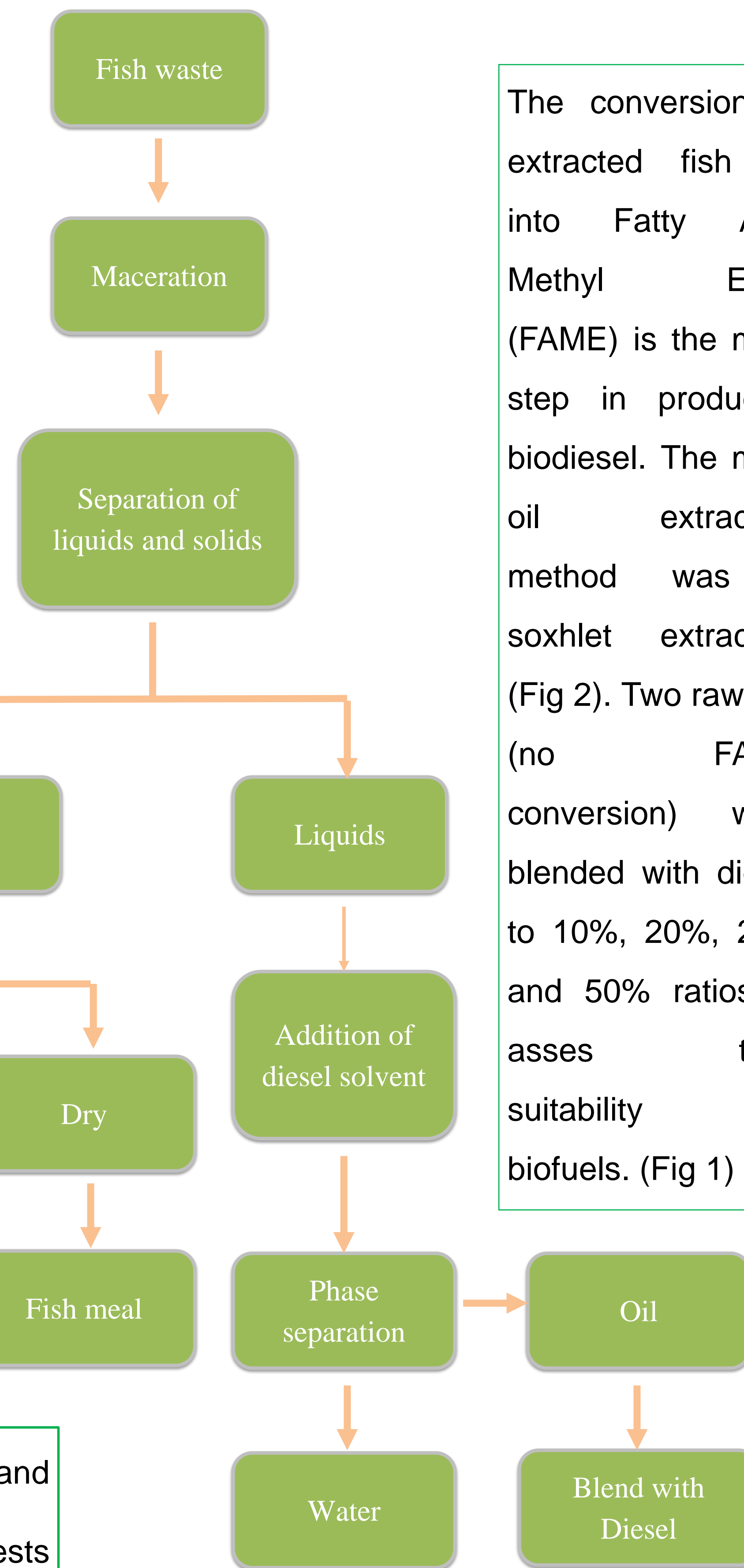$$+\frac{1}{8}(4c + h - 2o - 3n - 2s)CH_4 + nNH_3 + sH_2S$$

Using Eq1. and the elemental composition of the fish waste and sludge, theoretical biomethane potential is calculated.

Fish waste from	Mt per year
Global capture	89.5
Caught to specifically produce fishmeal and fish oil	20.8
Aquaculture	52.5
Trimmings and rejects from food fish	5.5

Theoretical yield of methane from the Buswell equation	
Sample	litres of methane l/gVS
fish waste	0.36
sludge	0.47

Anaerobic digestion is a feasible method for the processing of fish waste and sludge to produce biogas. It is recommended that biomethane potential tests are carried out to give a more realistic and reliable result. In terms of Kilnsey Park Estate, there is potential for a small scale digestion plant on site.

Flow chart:
Fish waste → Maceration → Separation of liquids and solids → Solids / Liquids

Solids → Anaerobic digestion → Methane
Solids → Dry → Fish meal

Liquids → Addition of diesel solvent → Phase separation → Oil → Blend with Diesel
Phase separation → Water

The conversion of extracted fish oil into Fatty Acid Methyl Ester (FAME) is the main step in producing biodiesel. The main oil extraction method was a soxhlet extraction (Fig 2). Two raw oils (no FAME conversion) were blended with diesel to 10%, 20%, 20% and 50% ratios to asses their suitability as biofuels. (Fig 1)
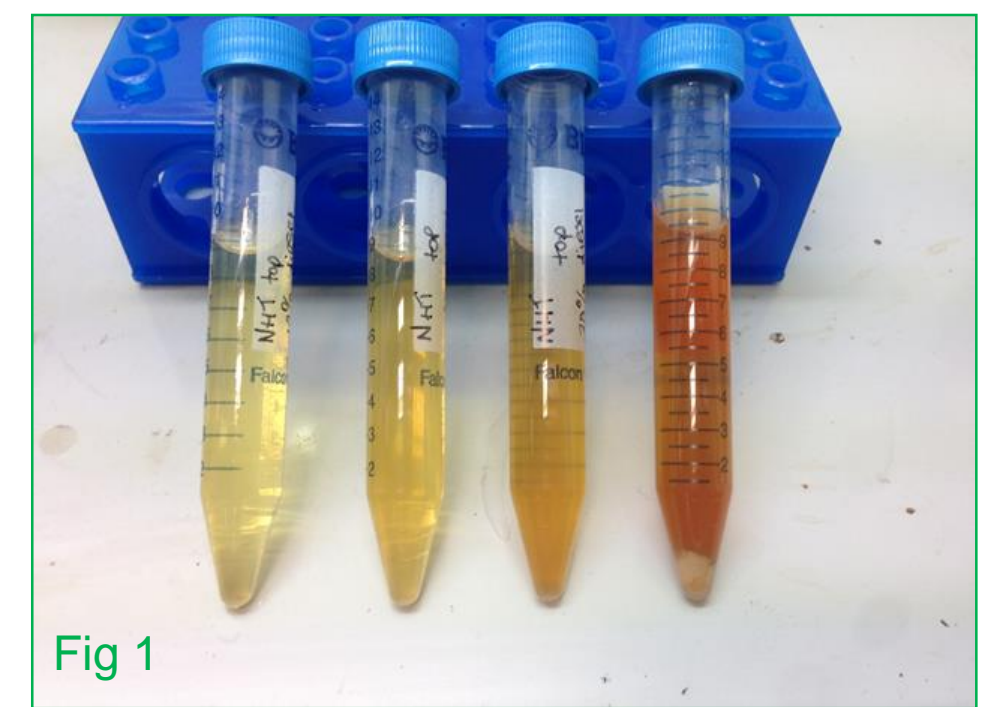

Fig 1

Coolant (H₂O) out
Condenser
Coolant (H₂O) in
Paper thimble
Solid material being extracted
Solvent passes through the thimble wall
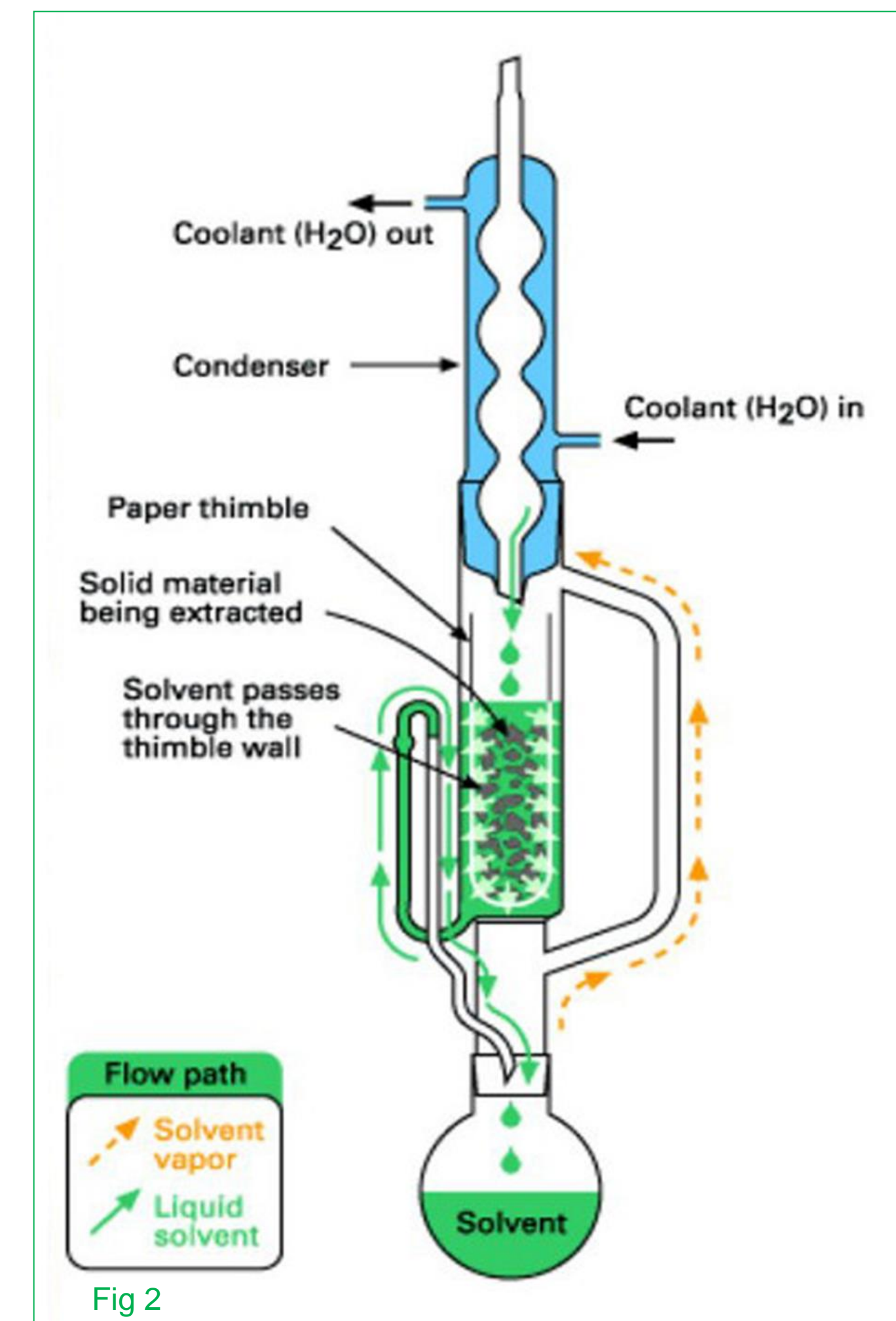Solvent
Flow path
Solvent vapor
Liquid solvent
Fig 2

The potential for Kilnsey Park to use its fish waste to extract oil is high. The yield from extractions is high and the oil blends well with diesel. This could be a financially viable use of their waste products.

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