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How to utilize fish waste in a sustainable and eco-efficient way



Fish waste utilization

- Unutilized fish waste causes emissions when disposed into landfill
 - Landfill gas
 - Smell
 - Leachate
- Fish waste can be processed into valuable products
 - Avoiding negative impacts while getting added value from waste





Fish waste properties

Fish	Fish part	Moisture	Lipid/fat	Protein	Ash	Reference
		wt-%	wt-%	wt-%	wt-%	
Pink salmon	Liver	77	3.3	19	1.5	Bechtel & Oliveira 2006
Trout	Head	70 ± 2.8	12 ± 0.6	14 ± 0.4	4 ± 0.3	Kotzamanis et al. 2001
	Frame	71 ± 1.4	11 ± 1.1	15 ± 1.2	3 ± 0.4	
	Tails	73 ± 1.5	7 ± 0.7	16 ± 1.1	5 ± 0.5	
	Mean of waste ²	70 ± 1.9	11 ± 3.1	15 ± 0.9	3 ± 0.9	
	Intestines	56 ± 2.8	35 ± 2.7	8 ± 1.2	1 ± 0.2	
Salmon	Head		16			Mbatia 2011
Salmon	Head	71	3.9	14	3.9	Jayasinghe & Hawboldt
	Viscera	78	1.8	17	1.8	2012
Salmon	Viscera	59	24			Sun et al. 2006

² Weighted mean of heads, frames and tails

Fish waste utilization



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- Fish oil and biodiesel production
- Biogas production
- Meal and fodder
- Fertilizers
- Industrial applications of fish oil
- Medical applications of fish oil



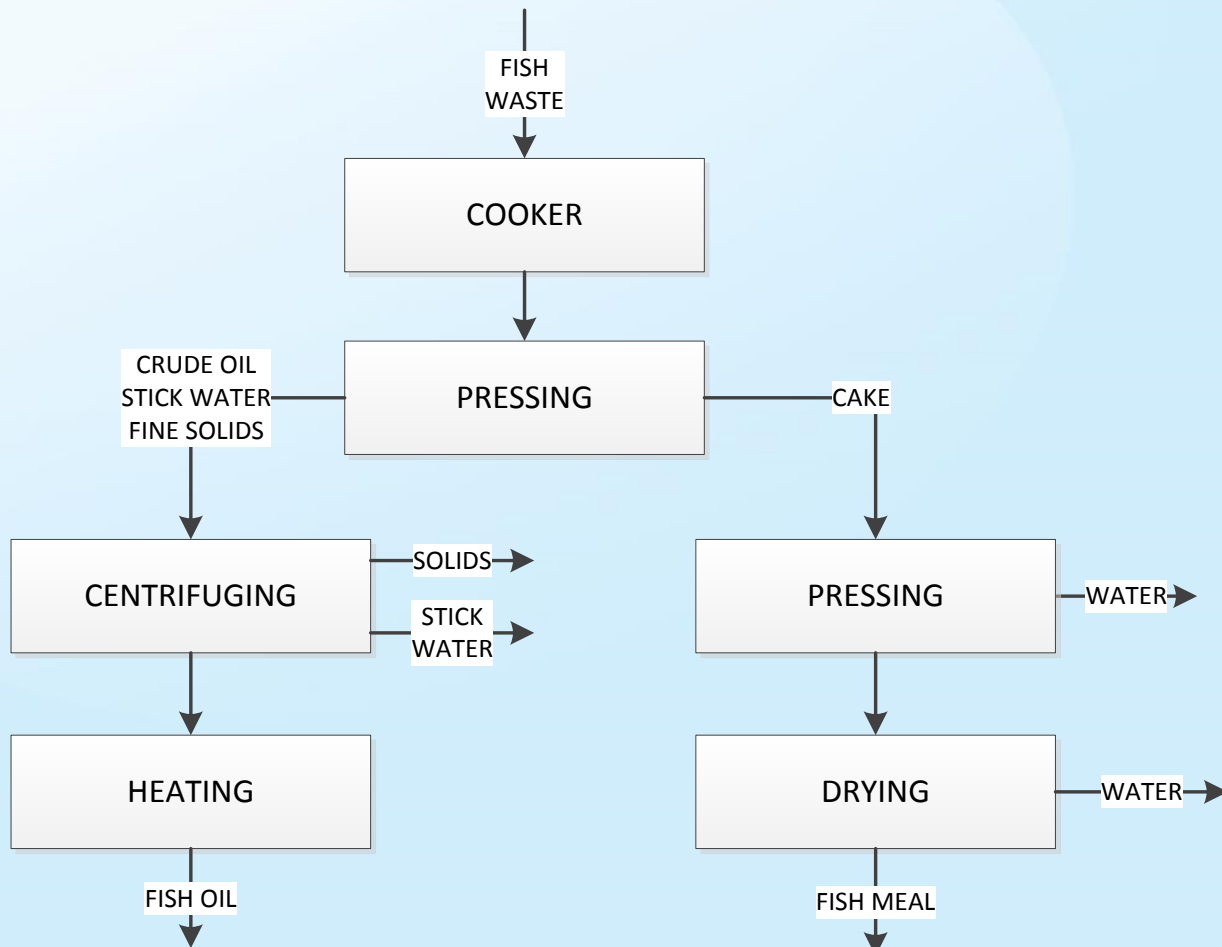


Fish waste utilization

- Fish oil separation
 - Crushing
 - Heating for enabling oil extraction in pressing
 - Pressing
 - Centrifuging of oil to remove solids
 - Heating of oil to remove water



Fish oil separation



Fish oil use



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- Fish oil use directly
 - Heat boiler
 - Diesel engine: complications from higher viscosity than biodiesel, does not burn as cleanly as biodiesel
- Oil free fish waste
 - Can be used to produce fish meal / fertilizers



Fish oil biodiesel

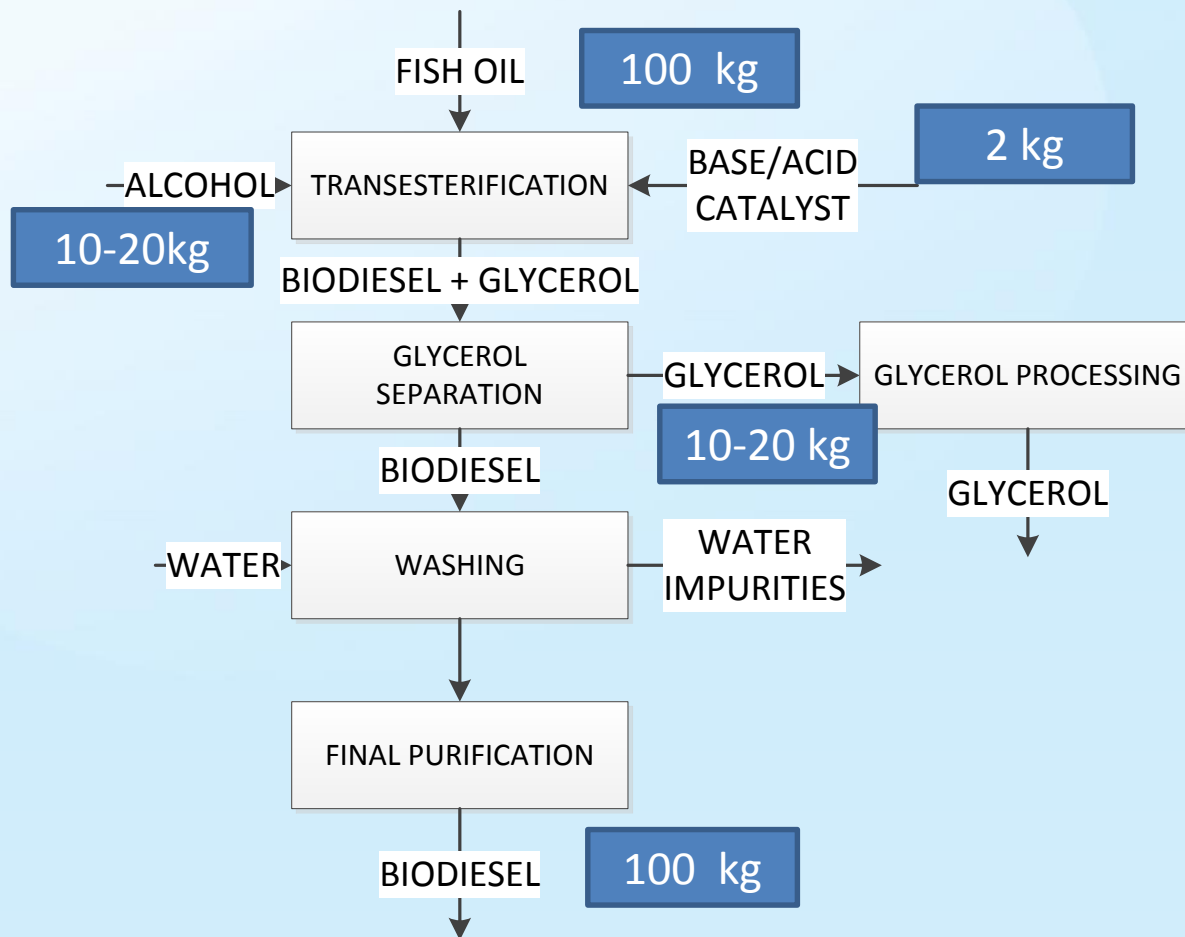


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- Biodiesel production by transesterification
 - Short chain alcohol: methanol or ethanol
 - Catalyst: base or acid (for example sodium hydroxide lye)
 - Usually: base catalyzed methanol transesterification
- 1 Fish oil mixed with alcohol and catalyst
- 2 Heating the mixture (for example 70 °C)
- 3 Separating glycerol and biodiesel
- 4 Cleaning the biodiesel



Fish oil biodiesel



Biodiesel production



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Biodiesel production from used vegetable oil
On a farm in Parikkala Finland



Erämaavirta Biodiesel production unit



Biodiesel



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- Is biodegradable
- Helps keeping the fuel system clean
- Higher flash point (minimum 130 °C) than regular diesel (minimum 52 °C) → safer
- Lower engine emissions than regular diesel
→ CO, PM, HC, NO_x



Biodiesel



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- Biodiesel will start to thicken at lower temperatures



Fish waste biogas



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- Biogas production by anaerobic digestion
 - Microbes consume organic waste and produce biogas (methane and carbon dioxide)
 - Digestate can be used as fertilizer
- Manure and sewage sludge could be utilized together with fish waste
- Oil-free fish waste can be used in biogas production
- Typical biogas production facilities
 - 5000 – 120 000 t/a feedstock



Biogas plant



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Biovakka biogas plant Vehmaa, Finland

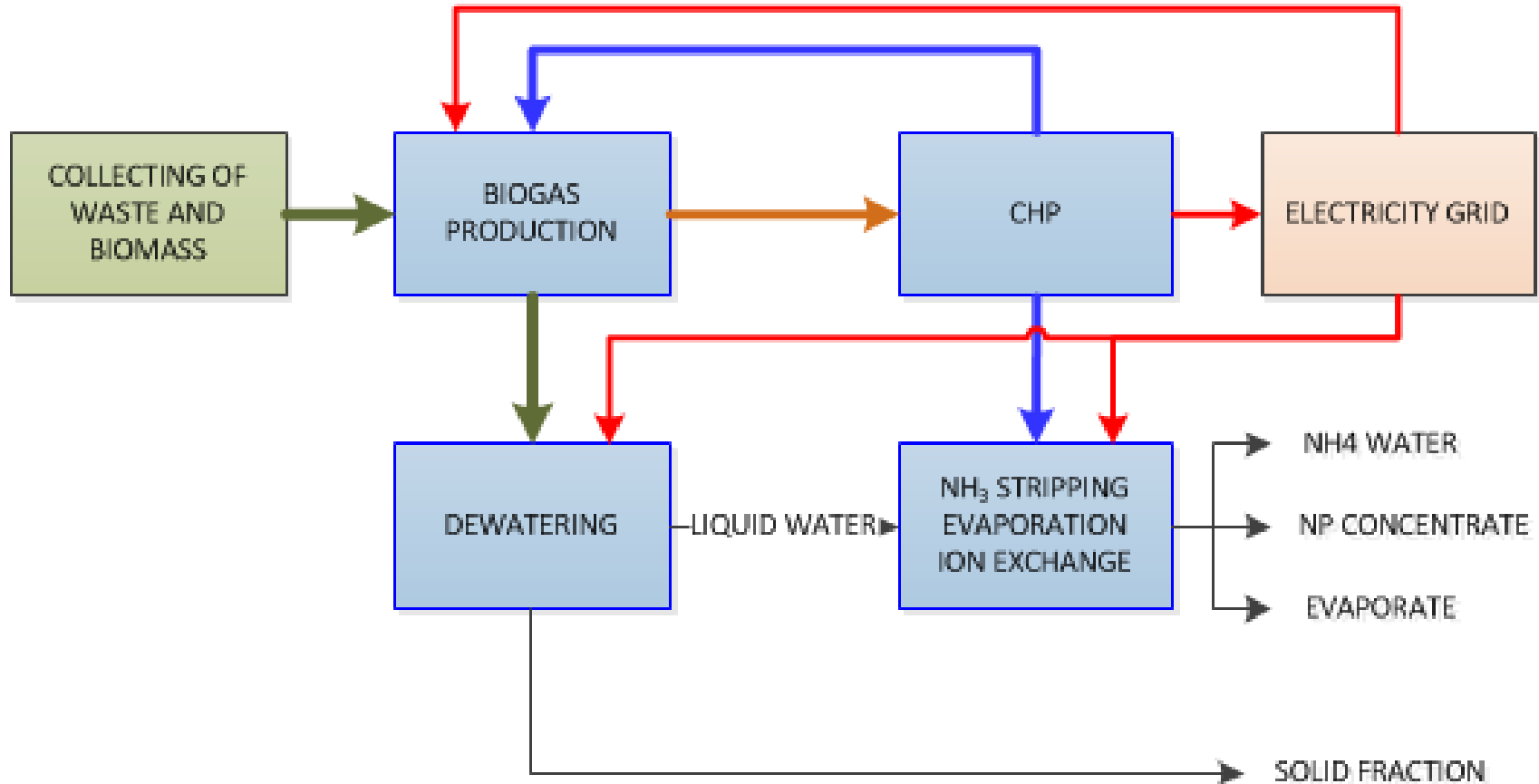
<http://www.biovakka.fi/vehmaan-biokaasulaitos>



Biovakka



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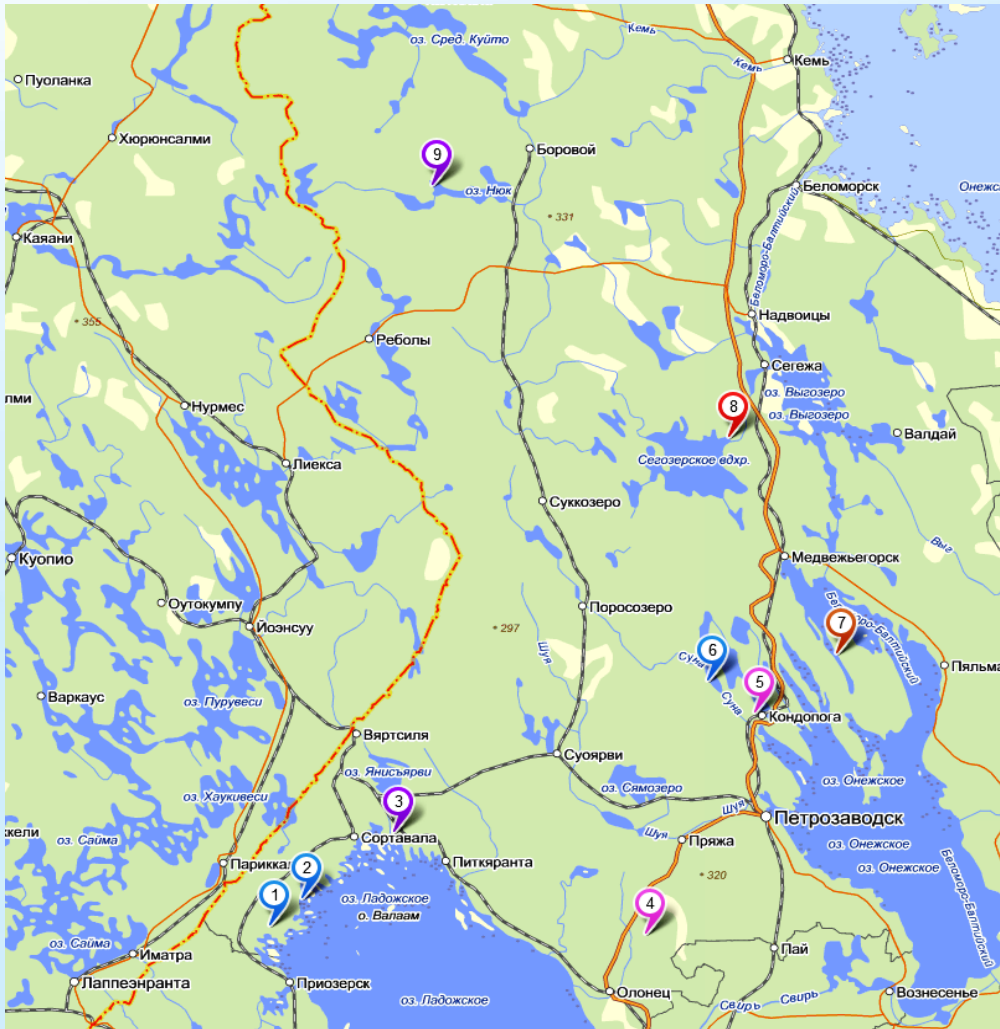
Biovakka biogas plant Vehmaa, Finland

<http://www.biovakka.fi/vehmaan-biokaasulaitos>

Fish processing plants in Republic of Karelia



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Potential in Republic of Karelia



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	Fish waste
	t/a
LLC "Rayguba"	560
PE N.V. Fedorenko	150
Ltd. "Kala ja maryapoyat	150
LLC "Segozerskoye	300
Ltd. "Nordost Rybprom	500
LLC "Rainbow	100
Ltd. "RokFor	150
Kala Ranta	170
Ladozskaja Forel	500
Total	2580

Oil (10%)

260 t/a

As biodiesel (40 MJ/kg)

2900 MWh/a

Manure 340 000 t/a

Biogas 85 000 MWh/a

Sewage sludge 11 000 t/a

Biogas 3 100 MWh/a





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Thank you for attention!

