

D22 Setting up and running a mobile processing facility

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Section 1: Mobile demonstration base unit power requirements.

For any mobile plant a source of external energy must be available to drive the factory. To determine the amount of energy needed for each different type of processing in the plant a set of calculations have been made. In the case of the mobile plant most of the energy will be supplied by the towing truck. In case the towing truck can be put to better use (hauling oil fruits), a spare minimum set will be put to use for operating parts of the total plant. This spare minimum set can be set up at such a scale that it can provide a small village with electricity, heat and refrigeration as needed by the village in times no full time production is needed. This is: basic preproduction of oil can be executed the whole year through without the need of extra power or the equipment delivered by the mobile factory.

This requirement does lead to the following power requirements:

Plant part, equipment type	Equipment specs power		Notes
	Heat/Cool kW	Elec kW	
Pre conversion equipment			
Boiling equipment	7 – 80 ¹	3 - 2	Not for all types of seeds
Drying equipment	22	1	Not for all types of seeds
De-hulling	0	0.5	Different types for different seeds
Pressing	6c ²	9	Multiple presses possible
Pre-filtering	1c	0.7	Simple gravity sedimentation or through filter cloth
De-watering (vacuumed cooking)	12	1	Simple vacuum pump (milking machine) possible
Storage press-cake	3c	2.0	Dry, possible cooled storage bin
Storage oil	0	0	Oil drums (1 barrel), multiple
Post conversion equipment			
Cooled post filtering	1c	0.8	Filtering with oil cooled to 20 degrees Celcius
Chemical FFA removal	0	0	Bleach earth filter.
Cooled second stage filtering	1c	1c	Filtering down to 5 micron with oil cooled to 35 degrees Celcius. (depends on type of

¹ Difference is in boiling cooking (or steam cooking) and just gentle heating upto 85 degrees Celcius

² Cooling requires electrical power. Cooling with these temperatures do have an efficiency of about 200%. This is taken into account in the electrical power required.

			oil)
Bio diesel production equipment			
Reactor vessel	2.1 ³		Warm water heated, insulated vessel.
Mixing pump		4	Same mixing pump is used as reaction pump, input pump and removal pump
Valves, air pressure controlled			At least 3 valves, Stainless steel or PVC HT
Compressor		2.2	For control of valves.
Methanol vessel		0.3	Closed vessel with external driven (slow) mixing device
Vacuum pump		1.4	Removal of methanol from end product
Cooling tube	3c ⁴	1.5	Cooling fumes to liquid (from 55 Celcius to 25 Celcius)
Centrifuge/ Sedimentation tanks/ Dry wash	0	0	Preferred solution is drywash with air in closed tanks. Production time 12 to 24 hours. Sedimentation takes about 48 hours. Centrifuge is quick.
Storage tank, filling station			Any tank can be used
Post processing			
Animal food press cake preparation	Do not buy. Partner search. Drying cost about 0,10 Euro/kg		Only for edible types, to be used directly, sell to animal food firm.
Glycerine upgrading	Search for partner		Amount to low, collect and move to re-work factory (soap factory).
Methanol upgrading	Search for partner		Small closed safe factory (dangerous work)
Chemicals recuperation	Search for partner		Soap factory: same chemicals are used in soap making. Boiler producing hot water.
Shells and other left-over's	Construct burner		
Utilities equipment			
Towing truck	Euro 3250		Moving equipment, delivering heat and electricity and compressed air
Trailers/semi-trailer	Euro 2750		Platform factory (factories) To be installed at common

³ Power required assumes already preheated oil of 55 degrees in vessel. Heat is just applied for keeping temperature at required temperature. Heating will stay on until new charge is loaded. Vessel is assumed to be well isolated

⁴ Simple cooled water by fridge, cooling down to 15 degrees for a flow of 1.5 liters methanol/hour removed by vacuum pump at 55 degrees.

Generator-set	Euro 1450	places To be installed at common places
Cooling units	Euro 450	places To be installed at common places
Compressor	Euro 299	places
Filter equipment	Euro 1500	Cooled filter with motor drive, constructed local
Filtermaterial 1 yr	Euro 350	Ply wood, multiplex
Construction material	Euro 185	waterproof
Pre filter pump	Euro 75	Clock pump, 50 ltrs/minute minimum
Post filter pump	Euro 75 – 0	Second pump or gravity drain
Cooling plate	Euro 50 – 0	Cooling plate refrigerator
Distribution oil	Euro 30	Distribution of oil over filter cloth.
Drive chain/motor	Euro 280	Moving cloth at speed of 1 cm/minute
Cleaning brush	Euro 35	Removal of fat, pieces of crushed shells and other large solid items
Left over collector	Euro 150	With heated stainless steel crude filter.

The calculations lead to a electrical power requirement of 50 kVA (30 kW) with a production of about 120 kWheat with full heat recuperation. Division of processing gives a power requirement of about 15 kW for each. The heating power requirements for all processing can than just be full filled. Using two separate generators of each 15kW -one driven by the truck, one driven by a standalone generator- there will be enough power to control the whole process.

Section 2: Estimation of costs mobile units.

The estimation of the costs is done through a ‘hands on’ approach: main elements are all build or re-designed to fit into transportable units. All elements already do exist but currently only in local (European) built style and shipped to other countries as a complete working installation. As knowledge transfer is the main key component of the project, most of the knowledge is in constructing the parts, these parts should be constructed in the donor country for the most part except for the parts which are not available. These parts are mainly the decision components of a plant which take the form of computer-controlled equipment, special designed parts and process knowledge.

In Appendix 1 the total cost for the base equipment, including filtering devices are calculated to be 9669 Euro. An extra amount of 3400 is required if the community wants to pre process the already harvest fruits. In that case a second generator, cooling devices and filter are in the community.

Much is still depending on the actual cost price and instruction time needed for building and operating the bio-diesel production facility. Based upon the building cost of a small factory (goods only) the following table gives an overview:

Equipment	Use	Cost
Vessel 250 litres, double, heated included mixing Stainless steel 304	Reaction boiler, 250 kg empty	650 EUR
Methanol mixing tank stainless steel 315	Methanol mixing tank mixing KOH with methanol. Includes drain and external slow mixing device 50 kg	550 EUR
Mixing pump SS 316 pump	Mixing methanol and oil with force for reaction to bio-diesel. 30 kg	150 EUR
Sieve tank, pressurized, stainless steel	Sieving of raw material through stainless steel mesh 150 kg	500 EUR
Valves, air controlled, multiple used (6)	Controlling the flow of raw, finished product 30 kg total	150 EUR
Flanges	Connecting pipes to vessel 60 kg.	160 EUR
Pipe material RVS (procesequipment), 60 m, 3 kg/m	Pipe material (50 mm) for connecting different vessels	400 EUR
Plastic pipe (PVC)	For longer distance transport of raw/finished product from/to storage tanks	550 EUR

Equipment	Use	Cost
Total material costs	Weight: 750 kg materials Weight: 2750 kg incl material	3310 EUR

All materials have been bought as used except the plastic pipe material. Computer control and measurement devices have not been calculated into this estimation.

The time used to set it up and build has currently taken about a 120 hours. For construction a number of tools must be available and quite expensive consumables are used. The tools required are: An Argon welding machine, a grinding device, drilling tools, turning machine. The consumables are: good quality drills, grinding and cutting materials, welding materials. During the construction about 1500 to 2300 Euro was being used on consumables.

Appendix 3: Decision model mobile factory or not.

If a mobile factory is feasible is not the question.

It is if the required materials and personnel are available at the set time. The decision will be more a choice between producing bio-fuels or use Straight Vegetable Oil. Main requirements for producing bio-diesel is the availability of the chemicals. The second requirement is the availability of the required materials, especially the stainless steel.

The availability of skilled personnel is a matter of time, but can delay the execution of the plans to a later stage. To make the decision based on the right parameters:

- Check upon the availability of stainless steel. Also check in neighbour countries.
- Create, install a manual operated test reactor and produce bio-diesel for a week from used cooking oil. Operate the device as it would be in a production environment, producing at least 120 litres/day, consuming the produced fuel in a generator driving the installation (about 10 litres)
- Iff (if and only if) the above operation succeeds, buy a small truck or trailer, load the processor and repeat above procedure in different communities with oil harvest from the land.
- Estimate the availability of the amount of oil to be used for conversion. If in an region with a radius of 50 km there is less than 8000 ltrs/year to convert, there is no use in converting.

The availability of the required chemicals will be less a problem if the volumes to convert rise: buying low volumes KOH/NaOH and Methanol is expensive.

About 4. Calculated on basis of an operation of 3 months, a daily allowance of 50 dollar and a price of 0.40 dollar per liter. 1 person is then guaranteed a yearly income of 4200 dollar. For paying the rent on the equipment a rate of 10 dollars a week is assumed. Maintenance is calculated at a rate of 240 dollar a year. The owner will earn a 265 dollar/year.