

Development modification kit; state of the art

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The modified Lister ST3, during its endurance test in the Netherlands



The modified Feidong, still under test in Chimoio, Mozambique

Case: Development of low cost modification kits for diesel engines to run on PPO

For Sub Saharan countries in Africa, small diesel engines that are used for maize mills, water pumps and sometimes generator sets, are the only locally available diesel engines around that could run on PPO and therewith create a demand for locally produced PPO. In many cases in Africa, DI engines are used, but during the survey in Cabo Delgado, quite a number of IDI engines were spotted.

For its pilot project in Mozambique, FACT is developing low cost modification kits for the latest Chinese Lister type engines that are imported and are in use in Cabo Delgado, since European modification kits are far too expensive .[1]

Since the project area is very remote with a poor technical infrastructure, the first kit was made in The Netherlands by PPO Groeneveld and a Lister ST3 (DI) was modified with it and an endurance test of over 650 hours running on PPO gave good results. See www.fact-fuels.org.

Following this test, a similar kit was built and a newly bought (IDI) Chinese Lister copy diesel engine in Cabo Delgado was modified and an endurance test started with the engine driving a water pump, running on PPO (from neutralized cotton oil) in Chimoio. This test is still running under real life conditions.

The criteria for development were:

- the modified diesel engine can run on (good quality) PPO of Jatropha or other PPO; but also, when there is little PPO available on diesel.
- The modification kits costs are restricted to USD 100- 200;
- The kits should be simple enough to be installed by rather unskilled technical people, with basic tools;
- The kits can be made from locally available material in rather simple workshops.

The kit as developed by PPO-Groeneveld consists of:

1. A two tank system, starting and stopping on fossil diesel, running on PPO;
2. A well designed heat exchanger of stainless steel pipe, through or around the exhaust;

3. A second filter;
4. Enlarged diameter fuel lines (10 mm)

Its costs are around US\$ 150 and fulfills the criteria mentioned above.

Design rules:

Most important input data for design of the heat exchanger are:

1. Engine power in kW
2. fuel use: between 253 and 265 g/kWhr
3. exhaust temp. max. 540 Degr. C
4. maximum allowable temperature of fuel coming out of the heat exchanger 65 Degrees Celsius, in view of non availability of PPO and the engine needs to run on fossil fuel.
5. Use stainless steel pipe instead of copper.
6. Mind danger of contact of fuel with exhaust as fire hazard,

For design rules and heat exchanger design see the [2] Development of a modification kit for diesel engines suitable for PPO, By G.J. Groeneveld.PPO Groeneveld December 2008.

Required maintenance:

The engine oil needs to be refreshed every 500 hours, since the PPO leaks a little into the engine housing, mixing with the engine oil.

Other maintenance is not different as prescribed by the producer of the engine.

The two engines above are of rather high speed (1500-up to 2000 rpm) IDI type (swirlchamber) and DI type.

For all use of PPO for the diesel engines, proper quality of the PPO according to standard DIN V 51605 (see Section 4) Is a must to ensure continuous operation. This is an issue that is not getting enough attention in projects in developing countries yet.

According Niels Ansoe, preheating by means of a heat exchanger in the cooling water, for water cooled diesel engines is a better option, because two disadvantages of the exhaust heat exchanger:

- 1 The system is vulnerable with regard to human operation. When at stopping the fuel is changed from PPO to diesel, the PPO which is in the pipe in the exhaust comes to a stand still, and should be closed off within a few minutes. If that is forgotten, the PPO in the pipe will be heated up to a temperature of over 200 degrees within 10 Minutes. That will cause cracking of the PPO which in turn will damage the engine parts, filter, fuel pump etc.
- 2 Te aforementioned danger of working with fuel in a very hot exhaust

The use of cooling water for heat exchange does not have these two disadvantages.

The cooling water has never temperature higher than 100 degrees., so the temperature of the oil in the heatexchanger can be controlled.

The design rules according Niels for a DI engine in Mozambican conditions are:

- 1 A 2 tank system;
- 2 extra filter for PPO that is preheated by the cooling water;
- 3 if possible extra pressure on injectors, by means of mounting extra spacer rings under springs of fuel injection mechanism.
- 4 Larger fuel lines

References

- 1 PlanOp_Devt_ModificationKit_29_05_08, J de Jongh May 2008
- 2 Development of a modification kit for diesel engines suitable for PPO, By G.J. Groeneveld.PPO Groeneveld December 2008.