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## Animal Fats Mixed With Liquid Hydrocarbons Combustion Efficiency

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**Animal fats mixed with liquid hydrocarbons combustion efficiency:** Combustion of animal fat is a necessity for leather processing industry environmental protection processes. Experimental researches were conducted in a pilot plant boiler with a heat output of 55 kW. The boiler was feed with a mixing of 30% animal fat and liquid hydrocarbons. Experiments were conducted in order to observe the maximum burning performances with minimum polluting emissions, but also to determine the methods to use this mixture with positive energy applications.

**Key words:** Animal fats, leather industry, combustion efficiency, renewable energy.

### EXPERIMENTAL PILOT PLANT

The experimental researches and validation were conducted on a pilot boiler, Multiplex CL 50 model, manufactured by Thermostahl Company. Boiler output heat is 50 kW -55, with practical use in indoor space heating, with a total volume of up to 1500m<sup>3</sup>.

The boiler can operate on solid fuels (coal, coke, lignite, wood, pellets) and is equipped with a grill made of cast iron and liquid fuel, through provision of a suitable burner, placed on the front door.

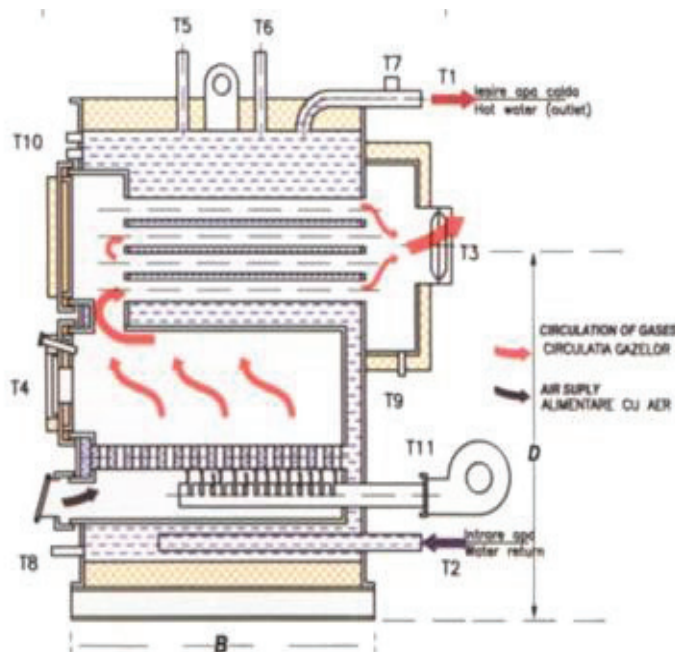


Figure 1. Thermostal CL 50 boiler, frontal view

The boiler includes a front camera, equipped with a barbecue burning flame spray liquid fuels placed above the grate. Water heating is realized by using smoke pipes placed horizontally in a convection exchanger placed above the furnace. The boiler is with natural draft. The combustion adjusting is performed using the air fan controlled by a control panel and a thermostat.

Due to its steel construction, the boiler has a good behavior to temperature variations. To avoid overheating, the boiler surfaces are cooled completely with water. High yield is given by:

- ✓ Large number of exhaust pipes burning
- ✓ Large volume of the outbreak
- ✓ Two roads flue gas at the top and
- ✓ Boiler water.

The boiler water temperature is controlled directly by the systems from a control panel equipped with: thermometers, thermostats and safety thermostat. When the water temperature reaches the desired level, the thermostat burner interrupts its operation. The optimum temperature is around 80°C but not below 60°C.



**Figure 2. Experimental pilot boiler mounted to water supply system and exhaust flue**

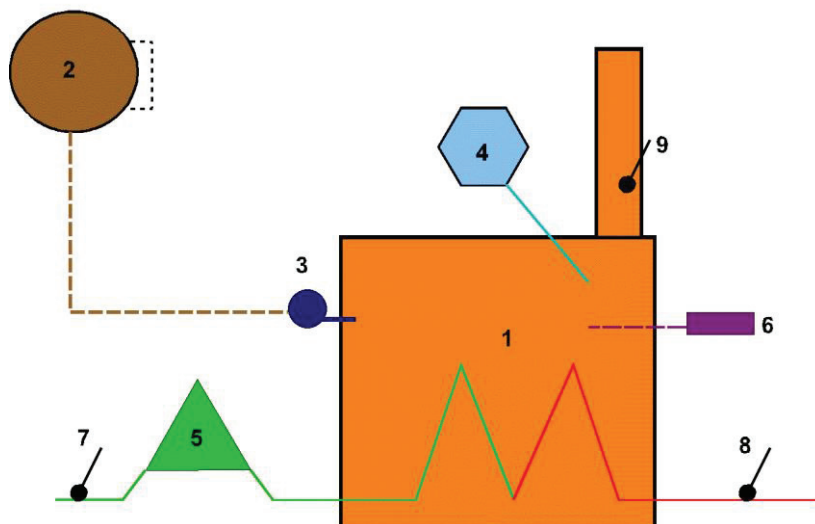
The used burner is equipped with a mechanical spray pump for a maximum pressure of 22 bars, with a spray nozzle flow rate in the return setting and with a swirl of air. The burner has embedded an electric heater to preheat the fuel spray to 75°C.

In figure 3 is presented the experimental research installation equipped with boiler and the measurements instruments. The installation components are: 1. Boiler; 2. Combustible tank; 3. Liquid combustible burner; 4. Multilyser burned gases analyzer; 5. Cooling water flow meter; 6. Radiation pyrometer; 7. Cold water thermometer; 8. Hot water thermometer; 9. Burned gases thermometer

The boiler net thermal load has been determined with the relationship:

$$P_m = Da \cdot 4,18(t_e - t_i) [\text{kW}] \quad (1)$$

in which,  $Da$  is the water flow [kg/s];  $t_i$ ,  $t_e$  are boiler inlet / outlet water temperatures.



**Figure 3. Experimental installation**

The yield on the direct route is determined with the relationship:

$$\eta = \frac{P_m}{B \cdot H_i} \cdot 100\% \quad (2)$$

In which  $B$  is the fuel consumption [kg/s],  $H_i^i$  fuel calorific power [kJ/kg].

## PILOT PLANT OPERATION

### Preliminary aspects:

- Tightness of fuel;
- User status discharging heat during experiments;
- Correctness of electrical connections under the scheme burner and boiler;
- Correct functioning of adjustment and safety elements;
- Operation of flame supervisor.

### Burner starting:

- Check the operating status of the control and protection elements on the boiler and set their value;
- The separating valve;
- The main switch engage;

Liquid fat is gradually dosed into fuel, for mass ratios of 10, 20 and 30%. The mixing can be done in the preheater mounted before the burner. Figure 4 shows the fat mass dosages.

Preheating temperature for burner is set between 45-50°C, in order to allow the total fats flow and pump power back burner (melting temperature of the fat previously determined in around 42°C) [1, 2].



Figure 4. The fat in the solid phase prepare for mixing dosage

### Combustion results of liquid hydrocarbons mixed with animal fat 20%

Operations general conditions:

- Boiler task, 55 KW;
- Natural draft;
- Burner pressure spray, 16 bars;
- Inlet water temperature, 17°C;
- Outlet water temperature, 60°C, is fixed automatically by the boiler control.

The flame had a completely bright aspect. There was noted the emergence soot, not in the flame and into the chimney as shown in Figure 5. Air needed for combustion was taken from the room where the boiler is placed and had a value of 30°C.



*Figure 5. Flame shape visualized by eye observation placed over outbreak*

The boiler efficiency (yield) varies between 69 and 72.6%, depending on the variation of excess air between 2.66 to 3.56, and the temperature of the exhaust gas in the chimney was between 284 – 337°C.

The main pollutant emission was the CO with CO value between 0.092 to 0.364%. The NO<sub>x</sub> emission was insignificant, the average being around 26 ppm. The pollution limits achieved by burning technology have been in normal targets, so the burning technology can be used at large scale [3, 4].

## CONCLUSIONS

Animal fat burning technology by mixing them with liquid hydrocarbons has been developed as an application for leather wastes which are in significant quantities [5]. It has been developed a technology with a slight burning application, spray mechanical fuel heated in two stages. Pre-heating temperatures depend on the quality of the animal fat and the characteristics of the burner. The experimental tests have demonstrated quality combustion and emissions to an acceptable level.

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**This paper has been reviewed.**