Future Trends of Biofuel Engines With Elsbett-technology

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INTRODUCTION

Both animals and plants create fatty deposits as an energy reserve - the former in their reproductive organs, the latter in their vegetative organs. The vehicles for the reproduction and dissemination of plants are seeds. In these seeds the energy deposit is frequently formed by fatty matter. The seeds can also be surrounded by fatty fruit pulp.

Plants which produce large amounts of oil are known as oleaginous. Of these only about ten are used for commercial purposes. Some others are used from region to region in a semi-extractive manner, while there are hundreds of little-known oleaginous plants, not yet used commercially, which can be excellent sources of fuel.

Even though the processing of vegetable oils to yield fuels similar to standard diesel is one of the dominating biofuel trends today, ELSBETT sees no future for it. It will disappear together with the ability of governments to heavily sponsor it, and together with the still existing problems of food overproduction in some countries.

VEGETABLE OIL AS FUEL

Oleaginous plants belong to various botanical families. This allows for an almost endless variety. Each of the Earth's various climatic regions has its own particular oleaginous plants. Tropical regions are especially fortunate as they boast a greater variety of oleaginous plants, while the favourable climate allows for greater productivity. The following qualities attributed to oleaginous plants growing in tropical climates are of utmost importance in tropical regions; ability to withstand drought, fire and contact with humans and animals, resistance to high and low temperatures, and ability to adapt to saline soil. The wide variety of oleaginous plants is significant from the agricultural point of view, and allows for crop rotation and crop combinations as shown in *Figure 1*.

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In the case of many oleaginous plants it is not just the oil which has economic or agricultural implications. Oleaginous plants combine some of the following features which mean they can be exploited in various ways.

The main by-product of vegetable oil is expeller cake. Sometimes the cake is the main commercial product and the oil becomes the by-product. Expeller cake which is high in protein, can be used to feed humans and animals, and is also highly effective when used as a natural fertilizer. Either way it is a natural recyclable product.

The other parts of oleaginous plants also supply different commercial often traditionally used products; medicines, teas, tannin, perfumes, fodder and material for simple constructions can be obtained from the leaves. Many of the fruits produced can be eaten directly or used in the making of juices and drinks, medicines, perfumes, colourings, starch and fibres. Wood, cellulose, colourings, medicines, charcoal and building materials can be obtained from the trunks, the bark provides the basis for tannin or can be used as material for rural constructions, the roots are also very important and provide starch, sugar and alcohol. Some oleaginous plants combine all of the above features which renders agricultural activity more profitable while producing recyclable energy.

Large-scale planting of oleaginous plants makes it possible to combat erosion, reclaim impoverished or desert land, reforest. The soil allows a better water control and management, and enables the fixation of nitrogen. In the above cases the simultaneous production of oil is an added advantage which results in increased income and allows for a diversity of products - as practised in many regions of the world.

ELSBETT TECHNOLOGY

It is precisely in this respect that ELSBETT sees an excellent way of confronting the problems inherent in the rural environment in tropical regions, such as lack of local energy to improve the production system, lack of infrastructure in which to store the energy, high cost of local energy, high cost for transporting agricultural

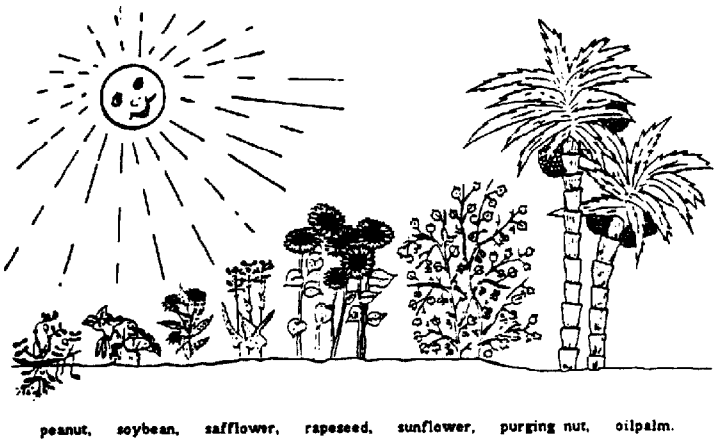

Figure 1. Crop rotation and combination

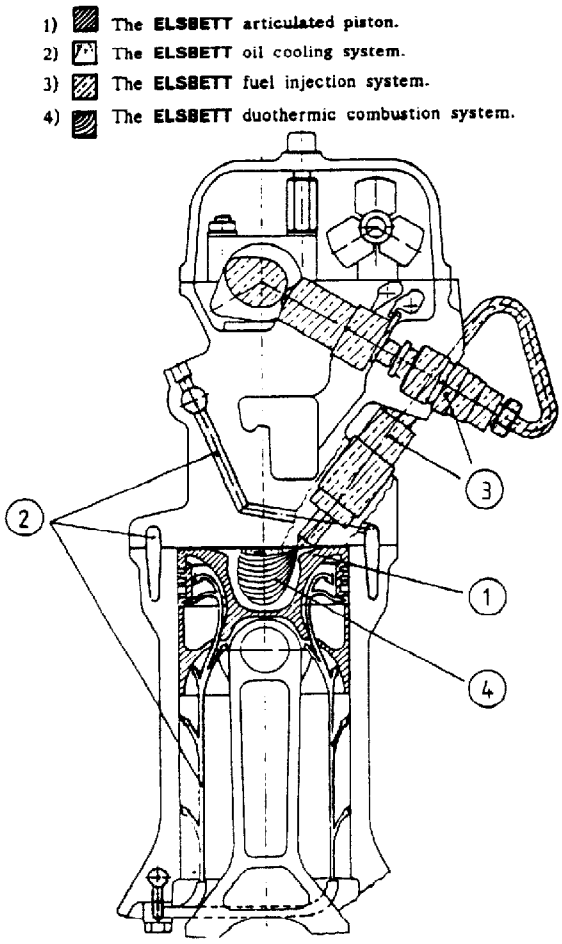

Figure 2. ELSBETT engine compon

products to the centres of consumption and distribution, rural exodus as a result of the unfavourable conditions of country life etc.

The application of ELSBETT technology to a rural energy programme based on a natural source of energy - the solar energy captured by the plant and stored in the oil gives the countryside the basic requirements for its development and prosperity. It enables irrigation, mechanization, the processing and storage of agricultural products, and increased comfort through energy self-sufficiency. Natural vegetable oil is the ideal fuel for the countryside.

ELSBETT technology describes a combination of advantageous engine components and design characteristics, as shown in *Figure 2.* One should keep in mind that those elements were developed and are necessary for the purpose to create a direct-injection diesel engine running on normal diesel fuel with low noise and emission output, with very good fuel economy and high specific power, especially when turbocharged.

Only by combining the various elements of the ELSBETT-Technology, it is possible to achieve the thermal and mechanical condition for an optimized and trouble-free combustion of alternative, renewable fuels, such as natural vegetable oils, which are slow to vapourise.

So, in fact, any ELSBETT-Technology engine is a real multi-fuel engine, adapting itself to the fuel being used and not requiring the costly and environmental risky adaptation of natural vegetable oils to undergo chemical processing (transesterifaction *etc*). The ELSBETT engine adapts itself to the fuel and does not require the fuel to be specially adapted to the engine.

FUTURE TREND

The real future trend for the biofuel which ELSBETT is seeing is the Natural Vegetable Oil Engine, *Figure 2.* However, it will become necessary to establish a standardization of such oils for the use of fuel, reducing dirt contents and other contaminations to levels as necessary for the ELSBETT engine as for any other engines.

The triglyceride molecule is made up of carbon (C), hydrogen (H) and oxygen (O) and its chemical structure constitutes the most effective and practical way for storing chemical energy produced by solar radiation and subsequently liberating it. It has high energy density (high calorific value), can be easily handled, transported and stored as it is a liquid, and is neither flammable nor explosive nor poisonous.

The ELSBETT duothermic combustion system, creates the ideal conditions for the burning of natural vegetable oils, which are slow to vaporize. The relevant characteristics such as density, viscosity and boiling point become of secondary importance to their use in the engine.

A clear future trend of biofuel engines therefore is the industrial and rural applications of such engines, *Figure 4.* A rural property, a farm settlement, an agricultural cooperative or an agrobusiness can become self-sufficient in terms of energy through the use of vegetable oil.

The growing of oleaginous plants can be incorporated perfectly into an agricultural system through combined crops, crop rotation or individual planting. As the oil can be obtained through a simple physical process, there is no need for technological capacity or large-scale investment in equipment, nor is there any need to supply additional fuels. Thus, vegetable oil can be obtained on a massive scale and can provide self sufficiency and independence in terms of energy.

Another clear trend of application of engines running on renewable energy is the application in schemes coupling the production of power and heat, see *Figures 5* and *6.* In such schemes, the fuel energy is efficiently used to a degree of 90% and over, doubling the normal fuel efficiency. The present engine sizes for this purpose are mainly between 50kW and 200kW mechanical power, applied for medium-size industries, heating of public pools and other social or public institutions, but the future will bring a mass-consumption of engines in the lower power end, such as between 5kW to 40kW mechanical power, used in the private sector for energy self-sufficiency in larger private houses being independent of the grid and from the supply of heating oil. In these applications, the use of clean and renewable fuels is a must, as fossil oils would be too polluting to be approvable in decentralized power stations.

CONCLUSION

The application of the ELSBETT technology to a rural property allows for self sufficiency from an energy point of view, and the energy can be used for agricultural

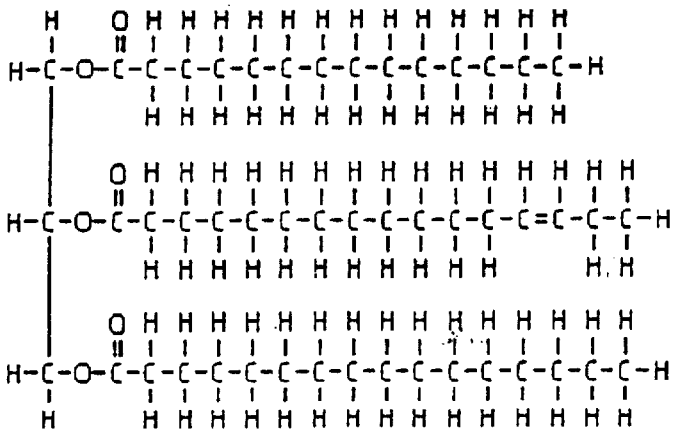

Figure 3. Example of a triglyceride

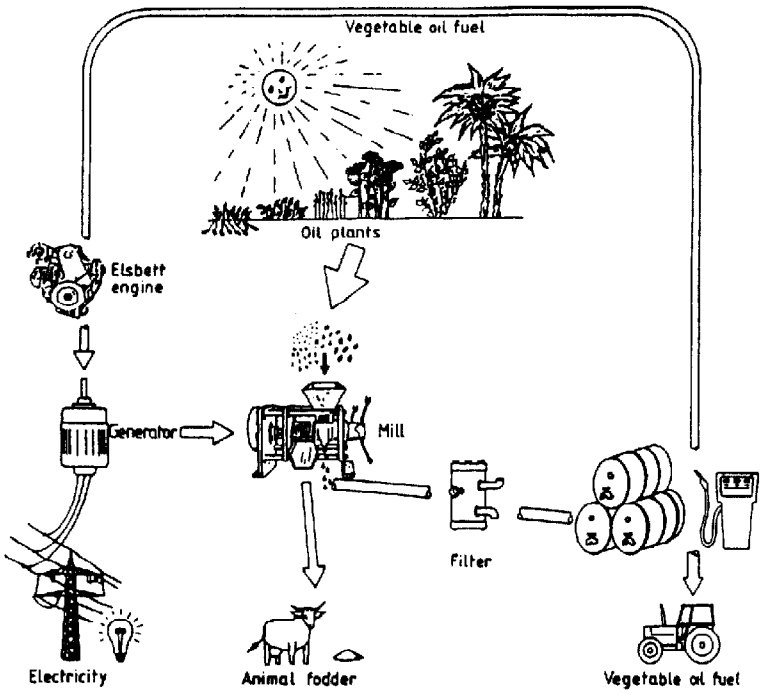

Figure 4. Industrial and rural applications of biofuel engine

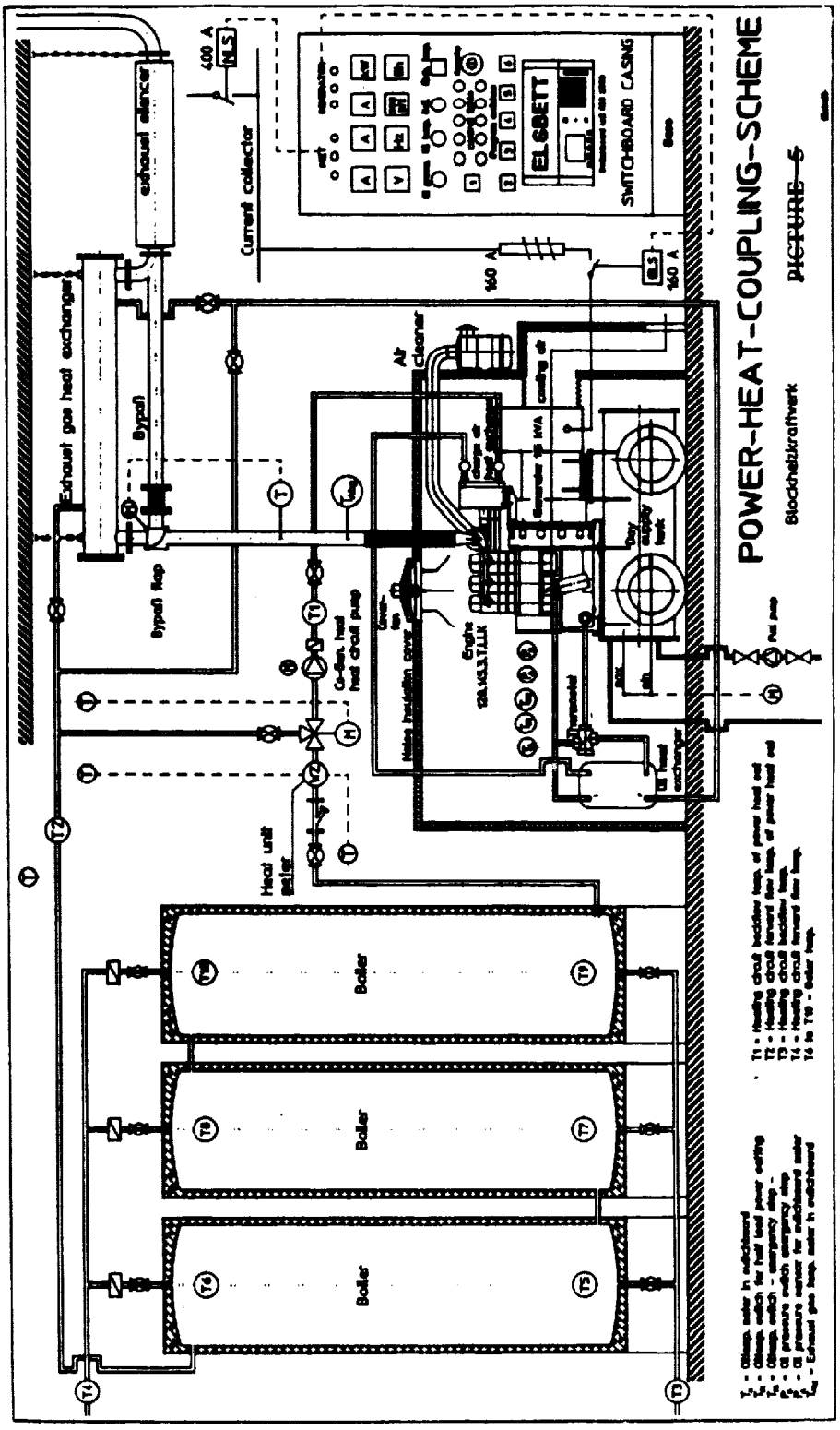

Figure 5. Production of power and heat

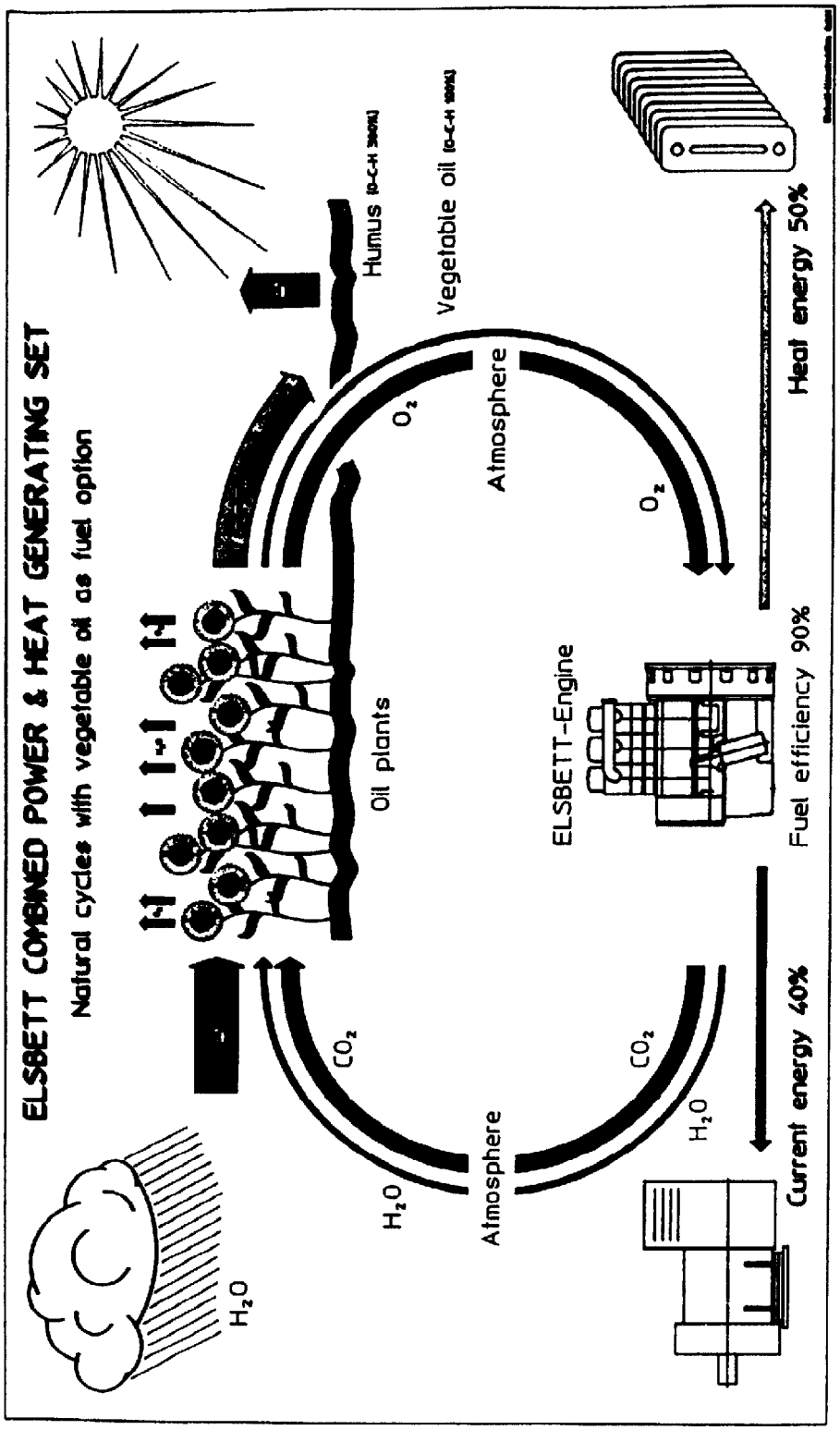

Figure 6. Elsbett combined power and heat generating test

mechanisation and systemization, irrigation and drainage as well as for the processing and preservation of other agricultural products or heating.

There is a real mega-trend for automotive engines with powerful and efficient direct-injection diesel engines, which is a good definition of the ELSBETT-Technology. It is not likely that most of these cars will soon run on vegetable oil as renewable fuel. It is rather likely that the sharply increasing number of cars world-wide will rapidly guzzle up the fossil fuels, as long as they are cheap and widely available; afterwards, a bundle of intelligent solutions, improved public transport etc. combined with a drastic change of driving behaviour will be necessary to keep alive the opportunities of individual mass traffic for the future generations. Using an improved engine and a better fuel can only contribute to the solution, but never solve the whole big problem alone.

In the heavy-duty power range of 50kW and over, it is an established practice to either recondition used engines or license the manufacturers of new engines to change the vital parts incorporating the ELSBETT-Technology.

However, it is unrealistic to believe that there would be great markets for engines made in a high labour cost country like Germany in the relatively low start-up production figures typically for biofuel engines. Such engines would always depend on heavy subsidising of the tax payer to be price-competitive, which has a natural limit and no commercial future.

The trend is rather that production will have to follow the markets, for example to a country like Malaysia with its high potential to produce vegetable oil as renewable fuel, its low labour cost, its dynamic economy and rapidly improving infrastructure.

Malaysia has shown a very good understanding, in a very early stage and against all obstacles to insist on local productions of passenger cars- it is likely that the same will happen, with the same success in the end, concerning the production of real biofuel engines with the latest design of ELSBETT-Technology, at least to close the gap from 5 - 40 kW industrial heavy duty power.

Another trend is set for passenger-car engines with latest-design ELSBETT Technology in the 100 to 150 HP-range, using in line 4 and V 6 - cylinder configurations. Such engines as mentioned above are able to compete in markets like the European community with its big excess of engine production capacity and its heavy battles over market shares.

Among other characteristics not yet displayed in public is the use of the double injection system, *Figure 7.* This was so far only experienced on large-size engines, and now can further improve the smaller sized industrial engines and the automotive engines with ELSBETT-Technology, in terms of combustion quality, better output and further emission levels.

ACKNOWLEDGMENT

ELSBETT would like to thank the people of Malaysia who always have shown their friendliness, hospitality and good business behaviour to us. Special thanks we give to the Central Government and its involved Ministries and Agencies, to the State Government of Sarawak, to the many friends, individuals and companies that have served as "guinea pigs" for ELSBETT's field tests, and of course to the Director General and staff of PORIM with whom we can celebrate 10 years of official cooperation later on in 1995.

During this period, Malaysia has become a second home for some of us, and we feel strongly committed to give our best to contribute to the further good and fast development in this country.