

A SHORT EXPOSITION

ON

„TBK-BIODIESEL”

A NOVEL BIO-FUEL AND COMBUSTIBLE

**INVENTORS: JANOS THESZ
 BELA BOROS
 ZOLTAN KIRALY**

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PRIZES WON AT VARIOUS SALONS OF INVENTIONS OF IFIA:

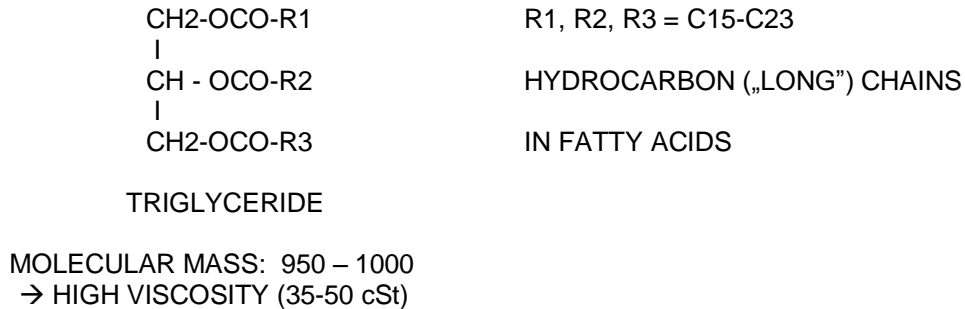
APRIL	2007 GENEVA	GOLD MEDAL
MAY	2007 KUALA LUMPUR	GOLD MEDAL
MAY	2007 WARSAW	GOLD MEDAL + CUP
SEPT.	2007 ZAGREB	GOLD MEDAL
OCT.	2007 TAIPEI	SILVER MEDAL
NOV.	2007 NÜRNBERG	SILVER MEDAL + SPEC. PRIZE
NOV.	2007 BUDAPEST	GENIUS DIPLOMA
NOV.	2007 BELGRADE	GOLD MEDAL
JAN.	2008 BUDAPEST	INVENTION OF THE YEAR
FEBR.	2008 BANGKOK	DIPLOMA OF MOLDAVIA UNIV.

2007-2008

A. GENERAL

USES OF BIOMASS OILS AND FATS AS FUELS

VEGETABLE OILS, SUCH AS RAPESEED, SOYA, JATHROPA, PALM-OIL, ETC. AND ANIMAL FATS SUCH AS BEEF TALLOW, PORK LARD, ETC. ARE NATURALLY OCCURRING TRIGLYCERIDES (FATTY ACID TRIESTERS OF GLYCEROL). THEY ARE A RENEWABLE SOURCE FOR ALTERNATIVE („GREEN”) FUELS IN DIESEL ENGINES.



FOR FUEL PURPOSES TRIGLYCERIDES CAN BE UTILIZED IN A NUMBER OF WAYS:

1/ DIRECTLY (AFTER REFINING): STRAIGHT VEGETABLE OILS („SVO”)

- → NEED PREHEATING ON ACCOUNT OF THEIR HIGH MOLECULAR MASSES/HIGH VISCOSITIES, TO BE ATOMIZED PROPERLY INTO THE COMBUSTION CHAMBER

PROBLEM: REQUIRES MOTOR MODIFICATION

- „SVO” WITH „THINNERS” (MICROEMULSIONS)

PROBLEM: INSTABILITY DURING STORAGE

2/ GENETICALLY MODIFIED TRIGLYCERIDES WITH „SHORT” – CHAIN (C₈ – C₁₂) FATTY ACID MOIETIES WITH ENSUING LOWERED MOLECULAR MASSES/LOWER VISCOSITIES

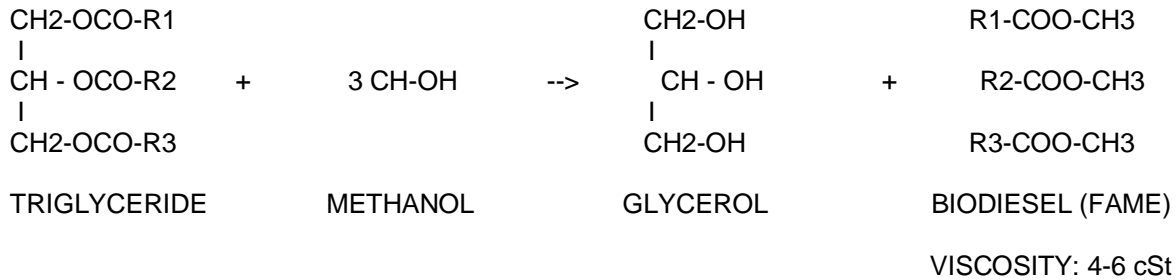
PROBLEM: PUBLIC RESISTANCE/TIME FACTOR

3/ THROUGH FRAGMENTATION OF TRIGLYCERIDES INTO SMALLER MOLECULES (WITH LOWER MOLECULAR MASSES/LOWERED VISCOSITIES):

A/ VIA CATALYTICAL HYDROCRACKING (E.G.: „NExBTL” PROCESS) → YIELDS HYDROCARBONS („PARAFFINS”) + WATER + CARBONDIOXIDE

PROBLEM: HYDROGEN IS FOSSIL (METHANE) DERIVED, OXYGEN CONTENT OF TRIGLYCERIDES IS LOST (NO INTERNAL OXYGEN REMAINS TO ENHANCE COMBUSTION AND TO LOWER PARTICULATE MATTER IN EMISSIONS), THE RESULTING STRAIGHT-CHAIN PARAFFINS HAVE HIGH CLOUD/MELTING POINTS → THE PROCESS REQUIRES AN ADDITIONAL ISOMERIZATION STEP TO GET BRANCHED-CHAIN SPECIES → EXTREME REACTION CONDITIONS → HIGH INVESTMENT/OPERATING COSTS

B/. VIA ALCOHOLYSIS → „BIODIESEL” (BD) OR „FAME” (FATTY ACID METHYL ESTER):



PROBLEM: 10 – 12 WEIGHT % GLYCEROL BY-PRODUCT IS FORMED → 10 – 12% OF STARTING TRIGLYCERIDES IS LOST FOR FUEL PURPOSES.

B. „THE GLYCEROL SYNDROME”

WORLD-PROBLEM OF ALL BIODIESEL PRODUCERS IN 2007: HOW TO OVERCOME THE „GLYCEROL-SYNDROME”?:

THIS SIDE-PRODUCT HAS VERY UNFAVOURABLE PROPERTIES:

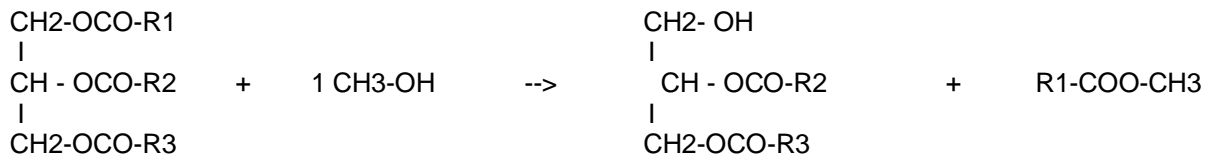
- CONTAMINATED WITH METHANOL, WATER, SALTS, COLOURANTS
- REQUIRES COSTLY REFINING
- GROSS OVERSUPPLY (OVER 500 000 TONS IN EUROPE ALONE)
- RAPIDLY ACCUMULATING/UNSALEABLE STOCKS
- ENVIRONMENTAL PROBLEMS ON ACCOUNT OF 60-70 LITERS SEWAGE/MT BD

SOME POSSIBLE OUTLETS:

A/ UTILIZING IT FOR MANUFACTURING ADDITIVES FOR BD (KETALS/ACETALS, TO LOWER POUR POINT AND CLOUD POINT)

PROBLEM: DECREASED HEAT OF COMBUSTION/LIMITED UPTAKE

B/ ONLY PARTIAL ALCOHOLYSIS OF TRIGLYCERIDES, WITH NO GLYCEROL FORMATION:



PROBLEM: FREE „OH” GROUPS IN THE PRODUCT →

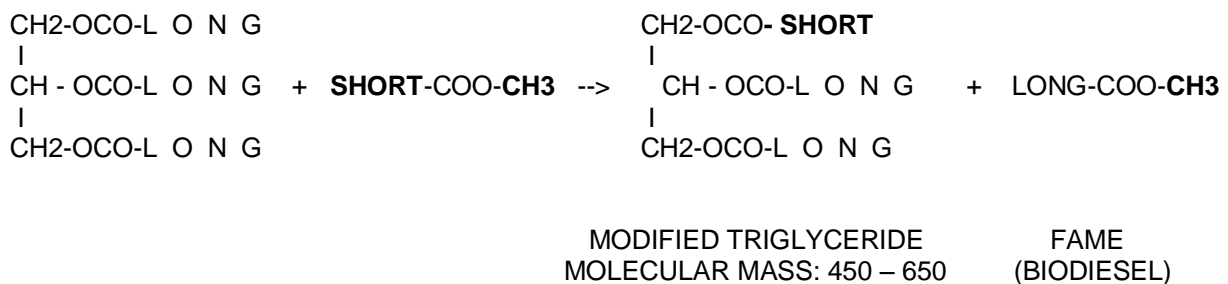
- INCREASED VISCOSITY
- ENHANCED FORMATION OF ACROLEIN THROUGH H₂O ELIMINATION → POLYMERISATION → CLOGGINGS/DEPOSITS IN MOTOR → FORMATION OF AROMATICS → LOWERING CETANE NO. + UNFAVOURABLE EMISSION PROFILE

C. OUR SOLUTION: „TBK” BIODIESEL!

A TOTALLY NEW CONCEPT AND APPROACH TO

- ELIMINATE AN ENVIRONMENTAL PROBLEM
- INCREASE BIOFUEL YIELDS OUT OF TRIGLYCERIDES BY 10%.
- INTRODUCE AN ECO-FRIENDLY, WASTELESS PROCESS

WE PERFORM PARTIAL TRANSESTERIFICATION (INTERESTERIFICATION) OF TRIGLYCERIDES WITH ALKYL ESTERS OF SHORT-CHAIN CARBOXYLIC ACIDS → CHEMICALLY MODIFIED TRIGLYCERIDES WITH REDUCED MOLECULAR MASSES → LOWERED VISCOSITIES, CLOUD POINTS AND POUR POINTS → NO GLYCEROL FORMATION, NO LOSS OF STARTING TRIGLYCERIDES, AS THEY ARE TOTALLY TRANSFORMED INTO ENERGY-YIELDING MATERIALS:



NOVEL BIODIESEL = MODIFIED TRIGLYCERIDES AND/OR THEIR BLENDS WITH BIODIESEL/PETRODIESEL

TYPICALLY A „TBK-BIODIESEL” FUEL IS COMPOSED OF 60-70% MODIFIED TRIGLYCERIDES AND 30-40% OF METHYL/ETHYL ESTERS OF DISPLACED FATTY ACIDS

ADVANTAGES AND FAVOURABLE PROPERTIES OF THE NEW BIOFUEL:

- EACH AND EVERY ATOM OF BIOMASS TRIGLYCERIDE IS UTILIZED FOR FUEL PURPOSES
- 30% MORE INTERNAL OXYGEN CONTENT → BETTER COMBUSTION, LESS SMOKE/SOOT
- UNIVERSAL PROCESS FOR ALL KINDS OF VEGETABLE OILS/ANIMAL FATS
- GLYCERYL MOIETY IS RETAINED → EXTRA YIELD OF BIOFUEL FROM BIOMATTER
- INCORPORATED CARBOXYLIC ESTERS → AT LEAST 15% EXTRA YIELD OF BIOFUEL
- AT LEAST 15% MORE PRODUCT → AT LEAST 15% MORE PROFITS
- AT LEAST 15% LESS ARABLE LAND NEEDED FOR FUEL PURPOSES → MORE LAND LEFT FOR FOOD
- BY INCORPORATING THE GLYCERYL MOIETY NO NEED TO HANDLE A BYPRODUCT
- „TBK” CAN BE PRODUCED IN PRESENTLY OPERATING BD PLANTS
- CONTINUOUS PROCESS, LOWER MANUFACTURING COSTS
- WASTELESS, ECO-FRIENDLY TECHNOLOGY, NO SEWAGE, MILD REACTION CONDITIONS
- GLYCEROL OF PRESENT PROCESSES AS FEEDSTOCK
- LOWERED IODINE NUMBER → MORE STABLE FUEL (BETTER OXIDATION RESISTANCE) → SUNFLOWER/SOYA AS FEEDSTOCK → TRIPLING AVAILABLE STARTING MATERIALS FOR BIOFUEL
- 5% GREATER VOLUMETRIC ENERGY DENSITY AS COMPARED TO BD
- 100% BIO RENEWABLE AS COMPARED TO BD (FOSSIL-DERIVED METHANOL IN FAME!)
- MORE FAVOURABLE COLD PROPERTIES (LOWER CP/PP)

D. EVALUATION OF THE NEW BIOFUEL

EVALUATION IS UNDER WAY. SOME PRELIMINARY FINDINGS:

- VISCOSITY: 5 – 6 cSt AT 40°C
- CP: – 13°C
- COPPER STRIP CORROSION: CLASS 1A
- MOTOR TESTS (10% BLEND WITH PETRODIESEL): SAME AS BIODIESEL, WITH BETTER TORQUE VALUES
- EMISSIONS: SUPERIOR TO BIODIESEL (50% LESS SMOKE)

THIS NEW FUEL (STARTING FROM RAPESEED OIL) MEETS GERMAN „RK-QUALITÄTSTANDARD” („QUALITY STANDARD FOR RAPESEED OIL AS FUEL”). HOWEVER, ON ACCOUNT OF ITS **GREATLY DIMINISHED VISCOSITY** IT IS SUITABLE FOR **ALL** KINDS OF DIESEL ENGINES **WITHOUT PREHEATING** (CONTRARY TO NEAT – „SVO” – RAPESEED OIL!)

Properties / Contents		Unit	Limiting Value		Testing Method
			min.	max.	
<i>characteristic properties for Rapeseed Oil</i>					
Density (15 °C)	kg/m ³	900	930	DIN EN ISO 3675 DIN EN ISO 12185	
Flash Point by P.-M.	°C	220		DIN EN 22719	
Caloric Value	kJ/kg	35000		DIN 51900-3	
Kinematic Viscosity (40 °C)	mm ² /s		38	DIN EN ISO 3104	
Low Temperature Behaviour				Rotational Viscometer (testing conditions will be developed)	
Cetane Number				Testing method will be reviewed	
Carbon Residue	Mass-%		0.40	DIN EN ISO 10370	
Iodine Number	g/100 g	100	120	DIN 53241-1	
Sulphur Content	mg/kg		20	ASTM D5453-93	
<i>variable properties</i>					
Contamination	mg/kg		25	DIN EN 12662	
Acid Value	mg KOH/g		2.0	DIN EN ISO 660	
Oxidation Stability (110 °C)	h	5.0		ISO 6886	
Phosphorus Content	mg/kg		15	ASTM D3231-99	
Ash Content	Mass-%		0.01	DIN EN ISO 6245	
Water Content	Mass-%		0.075	pr EN ISO 12937	

TBK PROPERTIES

905 – 920
> 220
38000 - 39000
5 – 6
- 13°C (cloud point)

0.2 – 0.3
100 – 110
4 – 5

10 – 20
0.3 – 0.4
5
5 – 6
0.005 – 0.01
0.05 – 0.06

SINCE „TBK-BIODIESEL” CONTAINS SUCH COMPONENTS (MODIFIED TRIGLYCERIDES) WHOSE CORRESPONDING COMPOUNDS (TRIGLYCERIDES) ARE VERY MUCH LIMITED BY TRADITIONAL BIODIESEL STANDARDS, STANDARDISATION OF THE NEW BIOFUEL – BASED ON THE ABOVE GERMAN DIN STANDARD – IS IN PROGRESS.

CERTIFICATE

Issued by: Szolnoki Főiskola Műszaki és Mezőgazdasági Fakultás, Mezőtúr (Hungary)
Tests performed: in the Institute Workshop, accredited by ENERGETEST Kft (Hungary)
Date: 13.07.2007.

Type of motor: PERKINS 1104

Engine brake: D-4 type water-brake

Measuring and qualifying system: Energotest

Fuel consumption meter: AI 2000 gravimetric

Types of fuel: -10 % TBK-K41 + 90 % petrodiesel

- 10 % TBK-K42 + 90 % petrodiesel

- 10 % TBK-K44 + 90 % petrodiesel

- 10 % RME + 90 % petrodiesel (as against)

Test purpose: Evaluation of novel biofuel „TBK” by comparing regulatory characteristics under full load

Evaluation of test:

1. Mixtures of biofuels and petrodiesel were tested under full load with engine brake. During the tests no malfunctions arose. The tests for the above-mentioned mixtures were carried out along with a „blind test”.
2. It can be concluded that the maximum effective power at 2100 rpm. were the same for all samples ($P_{\text{eff K41}} = 64,8 \text{ KW}$, $P_{\text{eff K42}} = 64,2 \text{ KW}$, $P_{\text{eff K44}} = 63,6 \text{ KW}$ és $P_{\text{eff RME}} = 64,6 \text{ KW}$, respectively). The same is true for the maximum torques at 1400 rpm. ($M_{\text{K41}} = 320,3 \text{ Nm}$, $M_{\text{K42}} = 322,2 \text{ Nm}$, $M_{\text{K44}} = 319,5 \text{ Nm}$, $M_{\text{RME}} = 319,1 \text{ Nm}$, respectively).
The minimum values of specific fuel consumption were identical: $b_{\text{min K41}} = 287,1 \text{ g/KWh}$, $b_{\text{min K42}} = 287,7 \text{ g/KWh}$, $b_{\text{min K44}} = 287,7 \text{ g/KWh}$, $b_{\text{min RME}} = 300,0 \text{ g/KWh}$, respectively.
3. Sample TBK-K41 was manufactured of rapeseed oil, TBK-K42 of sunflower oil, TBK-K44 of rapeseed oil, under modified parameters, RME is for „Rapeseed Methyl Ester”.

Recommendations:

It is to be stressed that the above values were registered under prevailing conditions without repetition. I recommend long-term tests along with field tests. Also, I propose qualification tests according to biofuel standards in an independent and accredited laboratory.

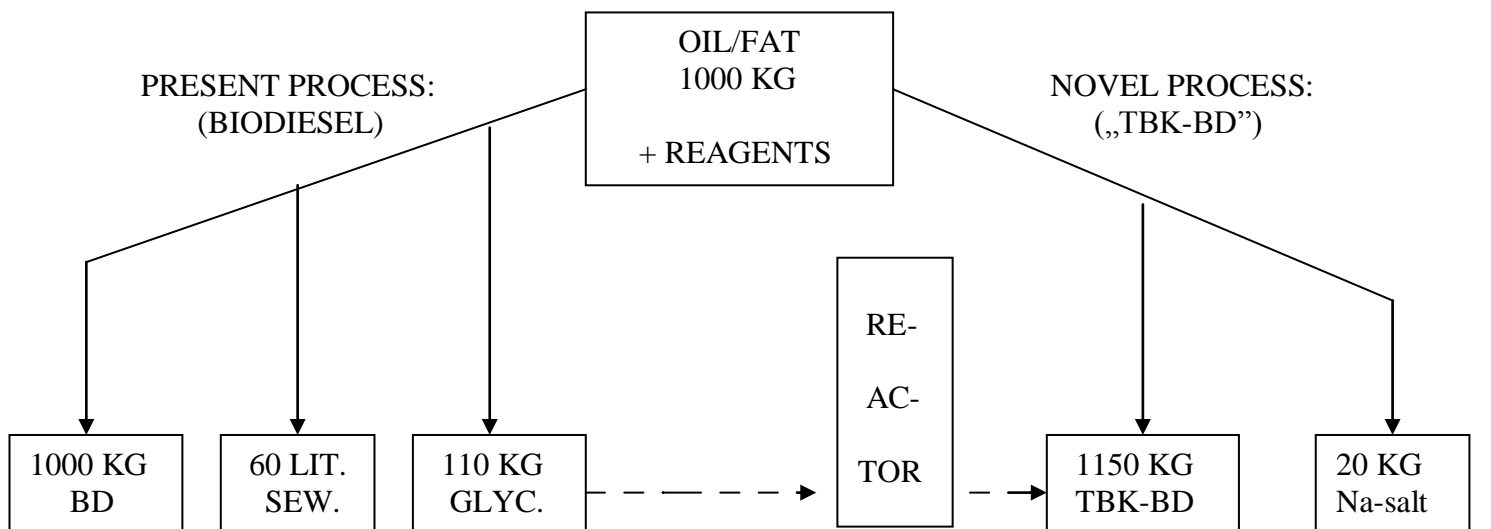
Mezőtúr, 13. 07. 2007

Dr. Farkas Ferenc Ph.D.
Professor of Faculty of Engines
H-5400 Mezőtúr, Petőfi tér 1.

E. ECONOMY OF „TBK-BIODIESEL” PROCESS

COMPARISON OF PRESENT BIODIESEL PROCESSES AND THE NOVEL TBK-BIODIESEL PROCESS:

IN PRESENT PROCESSES THERE IS A 12 – 13% LOSS IN TERMS OF STARTING BIOMASS TRIGLYCERIDES, ON ACCOUNT OF GLYCEROL FORMATION. IN THE TBK-PROCESS THERE IS NO SUCH LOSS, AS THE GLYCERYL FUNCTION IS RETAINED IN ONE OF THE FUEL COMPONENTS. MOREOVER, OWING TO THE INCORPORATION OF THE TRANSESTERIFYING AGENT, THERE IS AN EXTRA MIN. 15% GAIN IN TERMS OF FUEL YIELDS. SO ALTOGETHER THE TBK PROCESS HAS AN 15% EDGE ON TRADITIONAL PROCESSES. CONSIDERING A 100.000 TON/Y BIODIESEL PLANT THIS EXTRA MASS OF FUEL AMOUNTS TO APPR. USD 15 MILLION IN EXTRA REVENUES.



WASTES WITH ATTACHED:
DISPOSAL COSTS.

**E.G.: IN 2007 IN THE USA ALONE
70.000 MT (= 3.500 RAILWAY CARS)
OF DISPOSABLE GLYCEROL
WILL BE PRODUCED
→ USD 70 M LOSS IN FUEL**

GLYCEROL
AS FEED

**PART OF
THE NOVEL
PROCESS !**

**150 KG EXTRA
BIODIESEL**

**NO WASTE HERE !!
→ 15% EDGE ON BD
CONSIDERING A 100 000 T/Y
BD PLANT THIS MEANS AN
EXTRA USD 15 M IN REVENUES**



INVENTORS' MESSAGE:

Thanks are due to International Federation of Inventors' Associations (IFIA) for promoting introduction of TBK-Biodiesel on the International Forums.

Special thanks are due to Dr Andras Vedres, President of IFIA, along with his Associates for their professional support.

THÉSZ, János

BOROS, Béla

KIRÁLY, Zoltán

Please contact: Mr Janos Thesz at thesz@t-online.hu

