DIESEL FUEL VIA THE CATALYTIC DEPOLYMERIZATION

Transformation of wastes material in Diesel, water and fertilizer

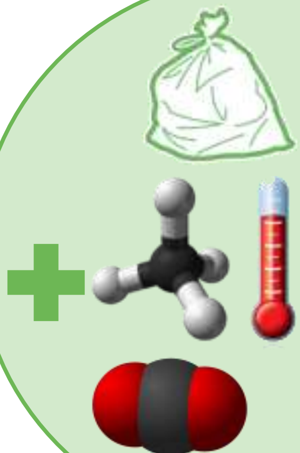
ALPHAK.A.T.

AGENDA

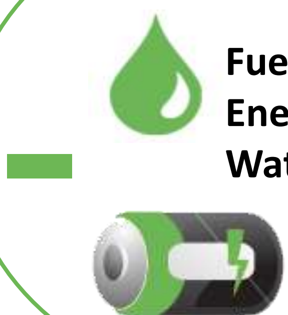
1. INTRODUCTION

Inventor Dr.-Ing. Christian Koch
Born in 1940 since 1967 in Franken (germany). Studied Process/chemical engineering
3 years associate professor at the engineering school then Reserch center Siemens
Since 1973 KWU Erlangen (Brokdorf/Grohnde, Licenncing and aproval processes EVA), Development
New Energies from waste materials, Gasification and start of the oil transformation technology.
Since 2003 Alphakat GmbH with the „Friktionsturbinen-Verölungstechnik KDV“
Construction of the plants Mexiko, Kanada, Hoyerswerda and Constanti/Tarragona (KDV 1.000)
Since 2009 Development of new High performance turbines for a broad aplication spectrum (150 to 5.000 l/h Diesel)

1. INTRODUCTION
1.1 Problems



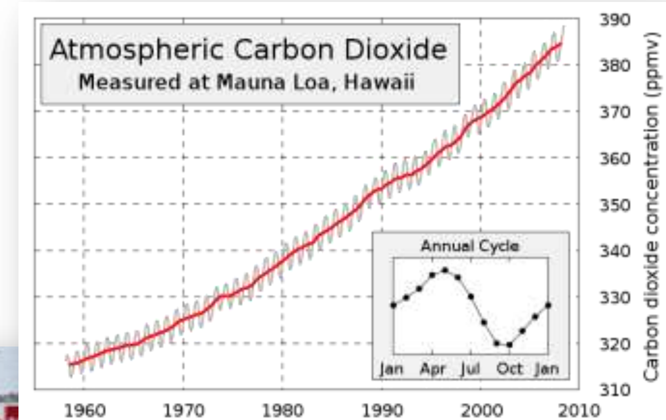
Waste
CO_2
Dioxines
Methane
Heat

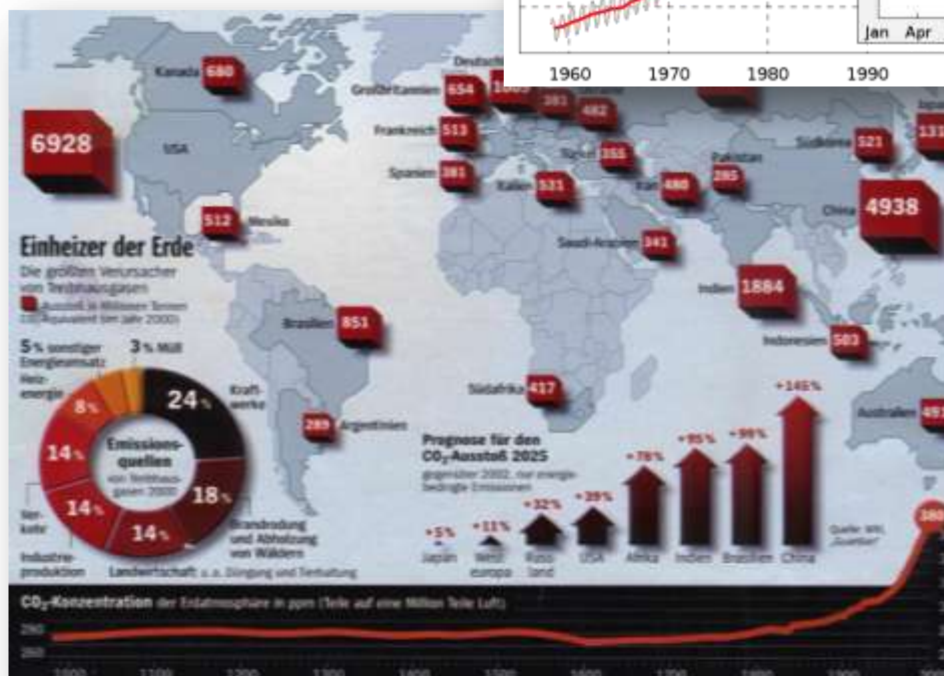


Fuel problem
Energy
Water

- More and more waste
- CO_2 rise (burning)
- Methan rise (combustion)

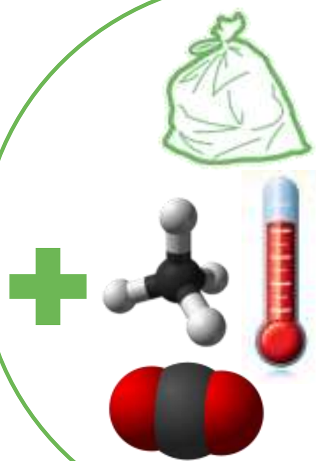
Heat production rise





Example CO_2 rise diagrams

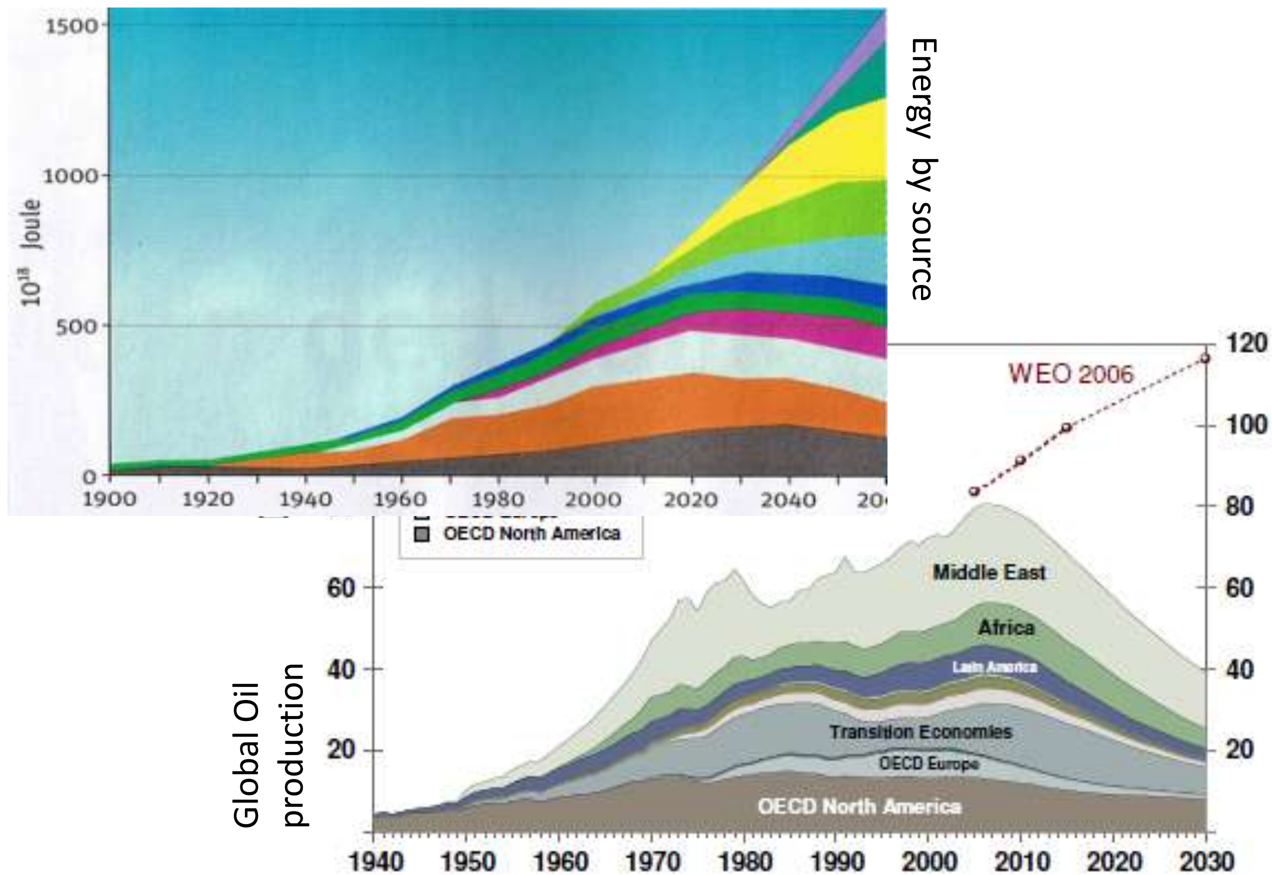
1. INTRODUCTION
1.1 Problems

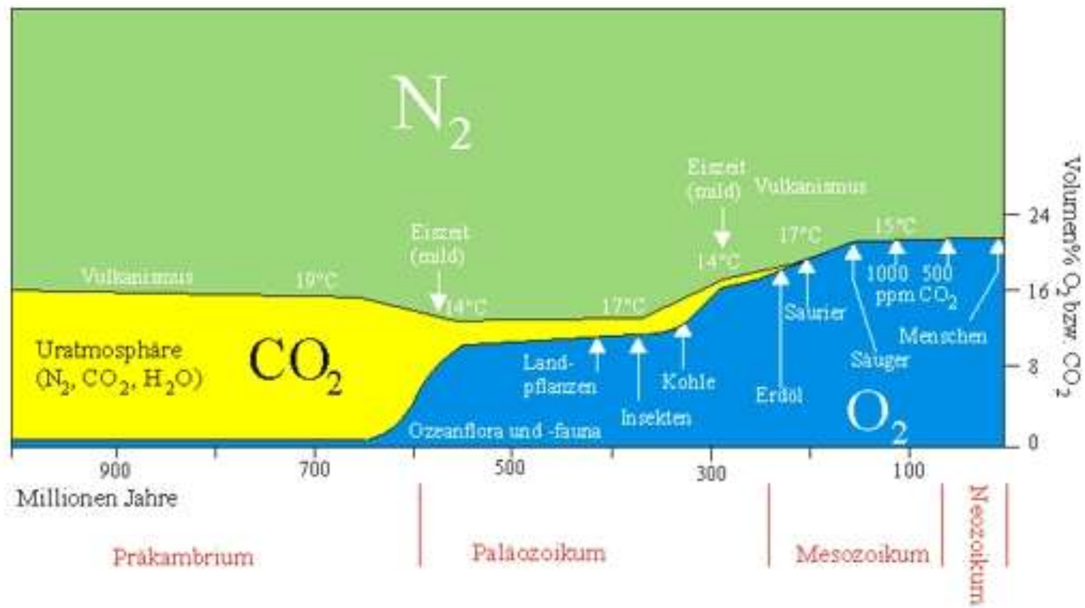


Waste
CO2
Dioxines
Methane
Heat

Fuel problem
Energy
Consumption

Limited fossil fuel resources
Rising energy consumption
Rising relevance of alternative energy sources





[19:43:10] Oliver Hartmann (TMT Factory): Accelerating 300 million years of the nature to 3 minutes with Alphakat

100% crystalline catalyst istead of minerals

280 – 330 Cº max temperature instead of natures 4Cº

BY NATURE: **300 Mill. years**

Step1

Conversion organics to bitumen with minerals and extraction of oxygen in form of CO2

Step2

Depolymerization from bitumen to oil

Step3

Depolymerization from oil to Diesel

BY ALPHAKAT : **3 minutes**

Step1

- **Mixing: Calatyst mixed with material.**
- **Adsorption: Docking of the catalist on material**
- **Reaction: New formation of hydrocarbons (diesel)**

Step2

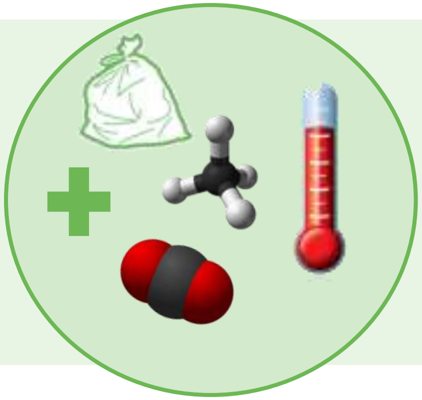
Spiltting catalyst from diesel

Step3

Destilation of diesel and water from calayst oil

1. INTRODUCTION
1.2 Solution

+ production of diesel or production of electric energy (peak power)
+ production of destilled water
Selfsufficient production process:
No additianal water needed
Uses aprox 10% of the diesel produced



+ no dioxins
+ no CO2 (CO2 is recycled except for the exhaust of the generator)
+ all waste can be converted (except for glass, metal, porcelan, stones)
+ low temperature/pressure process (low risk)
+ heat is re-entered in the dehydration process (no heat pollution)
The plant does not have a chimney

2. MAIN CHARACTERISTICS

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Inputs – Material

MSW (municipal solid waste)
All Plastics
Animal waste
Mineral oils
Sewage Sludge
Agricultural waste
Biomass cut material

Output

Diesel fuel
Destilled water
Ash = fertilizer (1-3%)
CO_2 (re-entered in the process)

Application

- **Fuel** (diesel, cars, jet fuel)
- Generator **fuel for electricity** (Peak Load)
- **Chemistry**

Conclusion

Changes convertible material into non-convertible material as a energy storage medium

Advantages:

- **No emissions**
- No usable material necessary for the input
- Efficiency (regarding the hydrocarbon content 65-90%)
pending on the waterparts of the input material)
- No temperature pollution with 300 degrees isolated in the production process

2. MAIN CHARACTERISTICS
2.1 Technology comparison

Conventional processes

- Waste combustion
- Waste gasification
- Pyrolysis

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Chemical processes
KDV (catalytic de-polimerization)
Magnesium or aluminium silicate

2. MAIN CHARACTERISTICS

2.1 Technology by emissions 1<2

Oil- and plastic residues

Emissions	Combustion	Gasification	Pyrolysis	ALPHAKAT
CO2 **remark**	100% - no firing added	80% - no FT-loss	50% - no methane consumption	10% - Own consumption
Dioxin	Allowable limit	Allowable limit	Exceeds allowable limit	No dioxins
Resins	none	Very problematic	Very problematic	None

Auto recycling material

Emissions	Combustion	Gasification	Pyrolysis	ALPHAKAT
CO2 **remark**	100% - no firing added	Not possible	50% - no methane consumption	10-20% - Own consumption
Dioxin	Allowable limit	n.a	Exceeds allowable limit	No dioxins
Resins	none	n.a.	Very problematic	none

2. MAIN CHARACTERISTICS
2.1 Technology by emissions 2<2

Domestic waste predryed (no metal, glass or ceramic)

Emissions	Combustion	Gasification	Pyrolysis	ALPHAKAT
CO2 remark	100% - no firing added	80% - no FT-loss	50% - no methane consumption	10% - Own consumption
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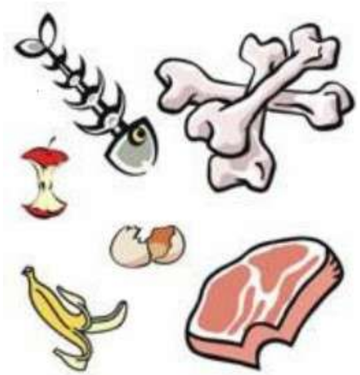
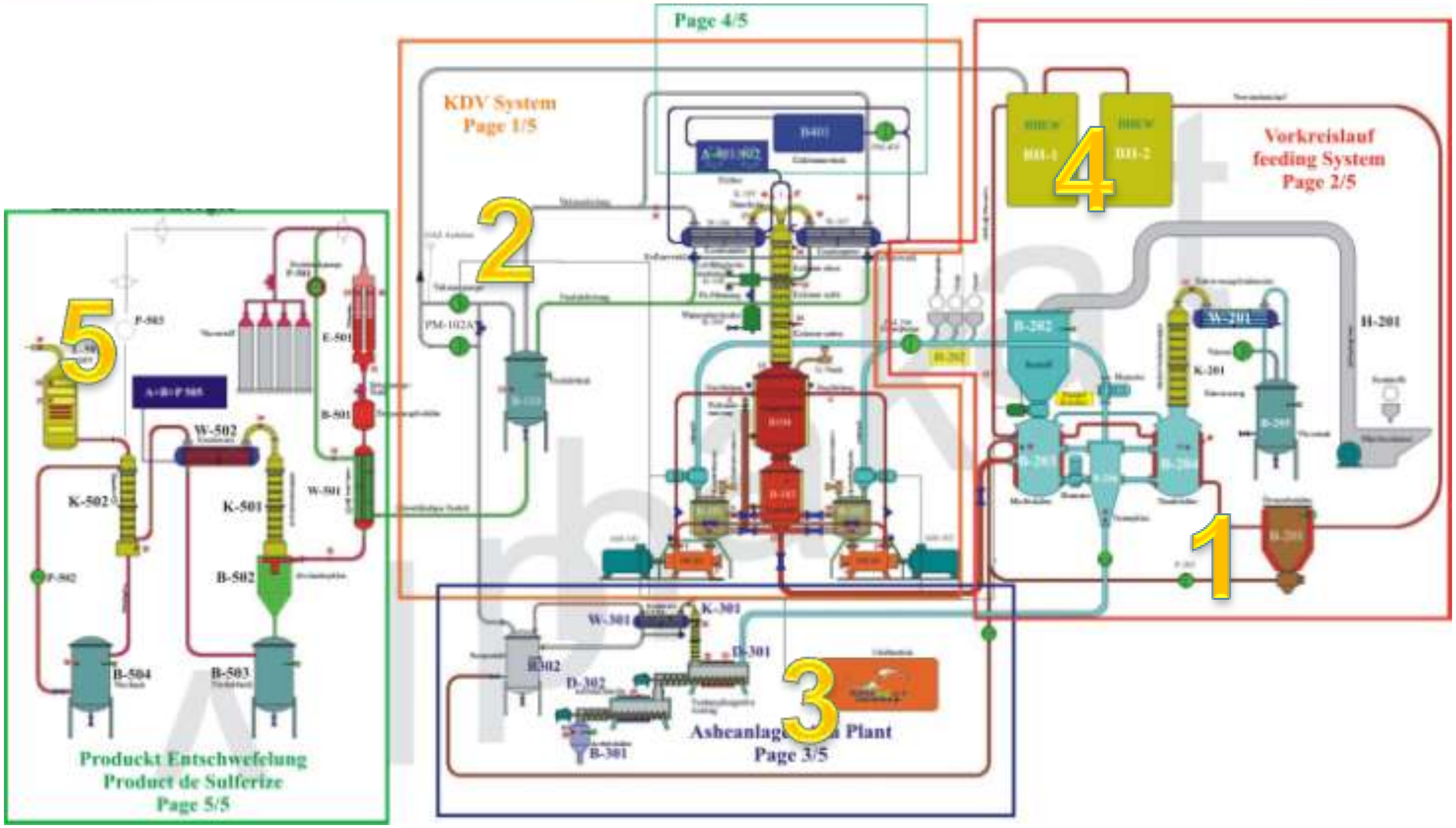


General impact: Energy Consumption

Emissions	Combustion	Gasification	Pyrolysis	ALPHAKAT
Energy consumption	800-1500ºC Depending on input material	750-950ºC Depending on input material	450-950ºC Depending on input material	280-300ºC

3.1 Plant Summary



1	SLUDGE PLANT
2	KDV PLANT
3	ASH PLANT
4	GENSET PLANT
5	OPTIONAL DESULPHURATION PLANT

3. SYSTEM FUNCTIONALITY

3.2 Inputs and feedstock

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INPUTS

MSW (municipal solid waste)
All Plastics
Animal waste
Mineral oils
Sewage Sludge
Agricultural waste
Biomass cut material

WASTE TREATMENT

FEEDSTOCK

- **Particle size:** Max 25mm diameter
- **Humidity:** Max 20% weight
- **Inorganics:** Max 5% weight
- **Calorific value**
- **Optimal mix** (biomass content)
- **Ash content**

PRODUCTION:

1,2 t biological mass = aprox 500L diesel depending on the water saturation.

- NO chimney necesarry
- NO heat pollution
- NO Methane / CO_2
- NO Dioxine

OUTPUT

- **Diesel quality** 65 “Cetan” (20% more efficient compared to the diesel of a regular gas station)
- Lower freezing point aprox. -60 Cº
- **Distilled Water**
- **1-3% ash (fertilizer)** binds hazardous materials

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PROCESS (after feedstock Input)

Process 1: Mixing, Adsorption, Reaction:

- Mixing: Calatyst mixed with material.

  Motor (consumption 3-10% of production)a diesel or electric motor or a gas turbine is used (helicopter)
  Turbine creates heat via friction of high speed revolutions

- Adsorption: Docking of the crystalized ion-exchanged catalist on the molecular bindings of the material

- Reaction: Molecular bundings are broken and formed new into saturaded hydrocarbon molecules without Oxygen

Process 2: Desorption Hydration and spilitting of the catalist from the diesel , water and ash

Process 3: Evaporation Destillation of the diesel and water.

- Diesel pumped in Tanks for quality control
- Catalist refreshed

Process 4 (optional): Hydrofiner seperates sulphur residues if necessary

PARAMETER	SIZE	PLANT DIMENSIONS*
PH9 **Depression 0,5 bar** **Temp. Max 320 Cº** **No chimney**	**150 l/h** **500 l/h** **1000 l/h** **2000 l/h** **5000 l/h** **modular**	**500 l/h = 25 x 25 x 10 m** **2000 l/h = 50 x 50 x 30 m** **5000 l/h = 100 x 100 x 30 m** (*) without transport, storage or separation logistics

3. SYSTEM FUNCTIONALITY

3.4 Production benefits and highlights

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BENEFITS

- The technological reproduction of the natural crude oil synthesis is ***accomplished within minutes***
- Synthetic fuel can be produced at ***competitive prices***
- The ***quality of ALPHAKAT-Diesel fuel is better*** than the EU-standards for conventional diesel fuel.
- ***No environmental pollution***. The technology binds inorganic harmful substances in salt induced by the ionic changing characteristics of the catalyst.
- ***Environmental protection*** becomes a source of energy and jobs.

HIGHLIGHTS

- The **ALPHAKAT** process can use all materials containing hydrocarbons with reduced content of water and inorganics
- The efficiency is regarding to the low reaction temperature (280 – 320ºC), and high conversion rates (about 65 – 85 %)
- The plant does not produce coke and needs no cleaning system.
- The plant has not heating systems. The heat is coming from the friction in the turbine avoiding hot surfaces that can ignite materials.
- The vacuum controls the safety of the plant and the input system
- The residue is produced in solid form and offers the opportunity for the recycling of the catalyst
- The consumption of the catalyst is very low and the cost of the process is very competitive.

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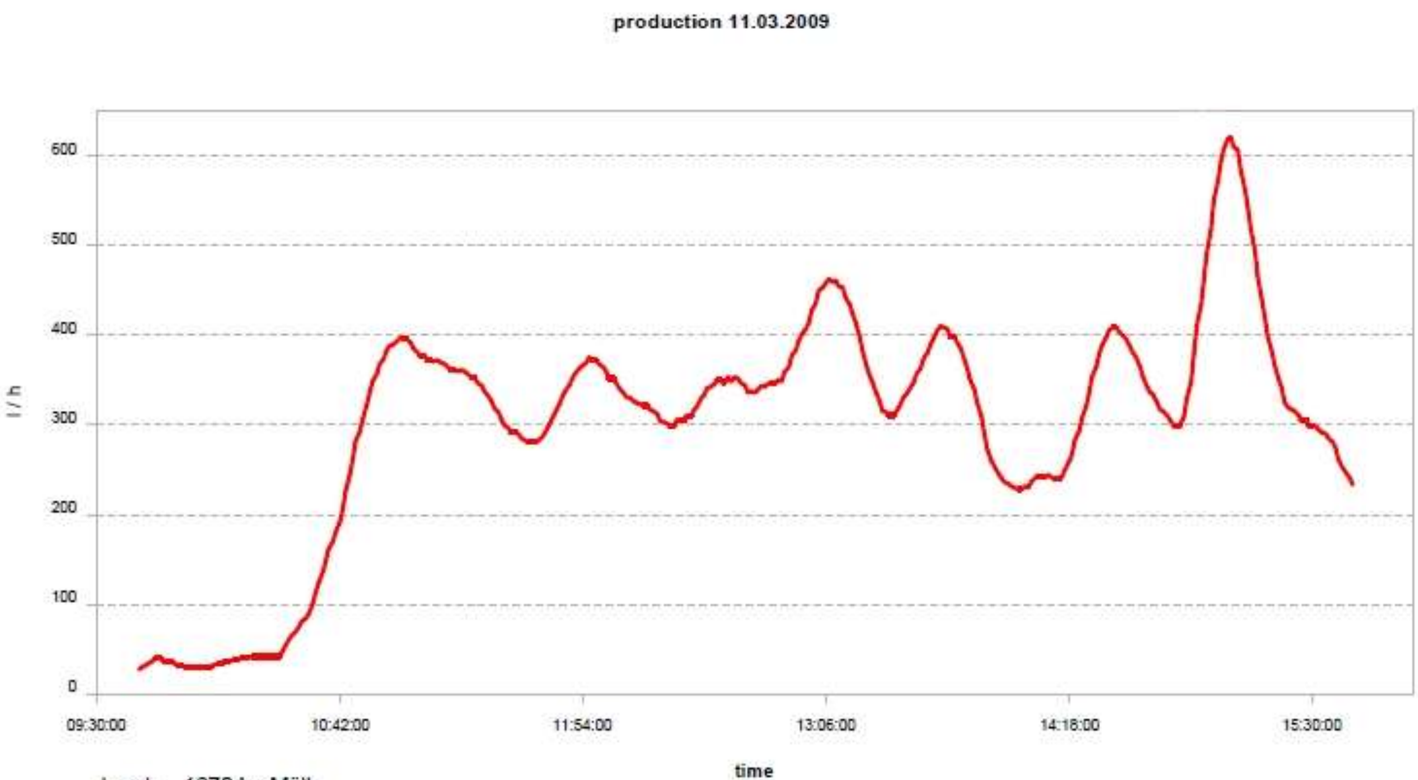


Input: 1670 kg Müll
35 kg Kathalysator
150 kg Kalk

Output: 100 kg für Ascheanlage
600 l Wasser
1200 l Diesel

ALPHAKAT GmbH ZukunftsEnergie

WASTE2OIL

Bearb. 18. Mrz. 2009 Kastelke

ITASKA

KDV 500

HOY

production 11.3.2009

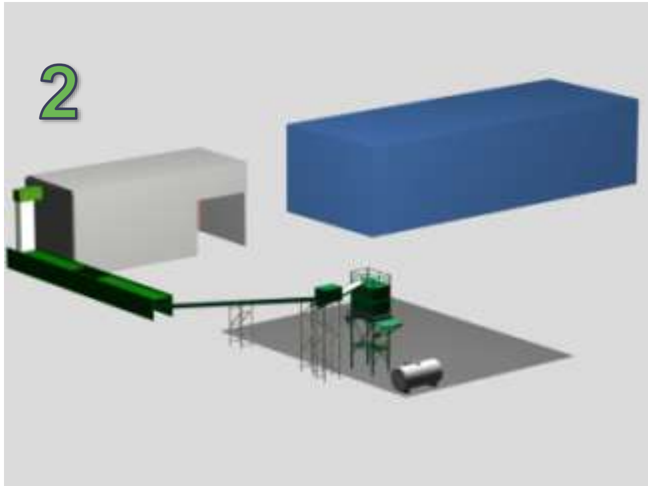
1 / 1

Waste2Oil Itaska

4. SCENARIOS

4.1 Industrial installation MSW Tarragona

Plant building with control center and electricity generators



Waste pretreatment plant: cleaning & shredding
Feedstock storage and transport conveyors
Feedstock hopper and dosifier

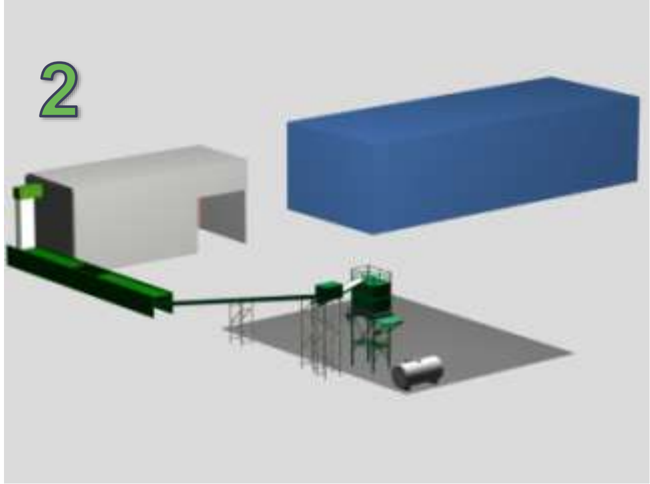
Alphakat Plan with connection to diesel tanks

Characteristics:

- Recycable plastics are separated and sold
- Organic waste is pre-composted (dehydrated)
- Diesel generators to create electricity to operate all components and vehicles of the plant

4.2 Example instalation biomass waste

Plant building with control center and electricity generators



Dehydration plant: drying & shredding
Feedstock storage and transport conveyors
Feedstock hopper and dosifier

Alphakat Plan with connection to diesel tanks

Characteristics:

- Modified feedstock preparation process
- Lower feedstock preparation cost

Examples:

- Sugar cane residues, sewr sludge, contaminated/oily soil/sand, "biofuel" plant mass, mineral oil residues, etc.

4. SCENARIOS
4.2 Example instalation biomass waste

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Biomass examples:

- **Sewer sludge**
- **Forrest waste**
- **Agricultural waste**
- **Energy through photosynthesis**
  "biofuel-" plants as source of feedstock
    - Plant deserts and cities with new type of plants as "Jatropha" having roots up to 10 m.
    - Harvest the plants without destruction and without implications on the food chain.
    - Create new jobs in planting, harvesting and conversion in diesel
    - Create social structures

Jatropha

-1000 has.
-8,000 tons Diesel per   year

Sugar cane waste

-1000 has.
-9,000 tons Diesel per year

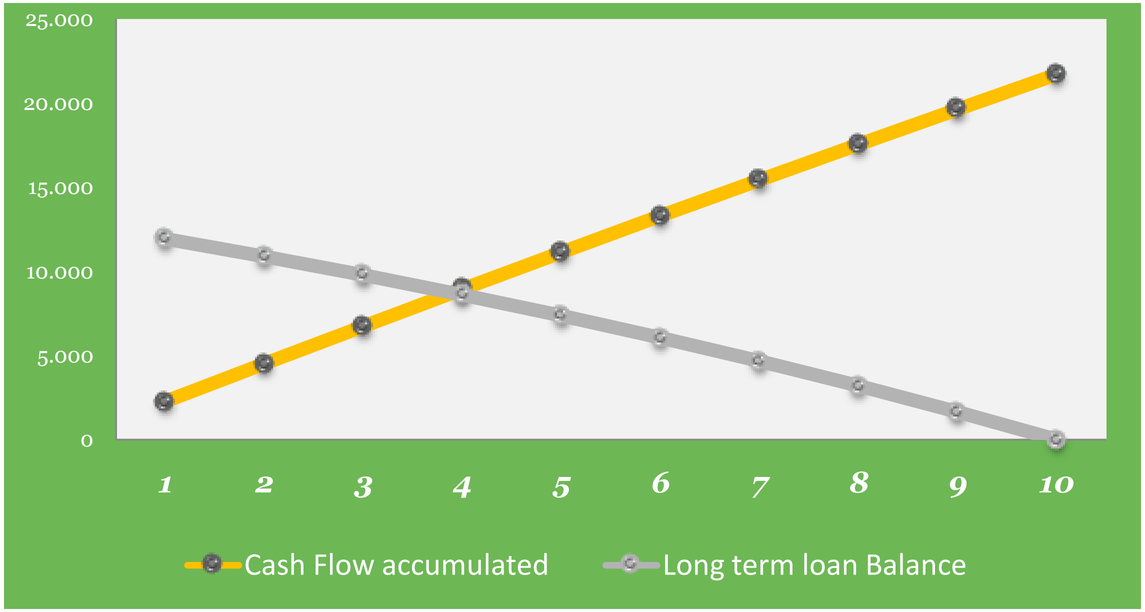
Palm oil waste

-1000 has.
-7,000 tons Diesel per year

5. ECONOMICAL FIGURES

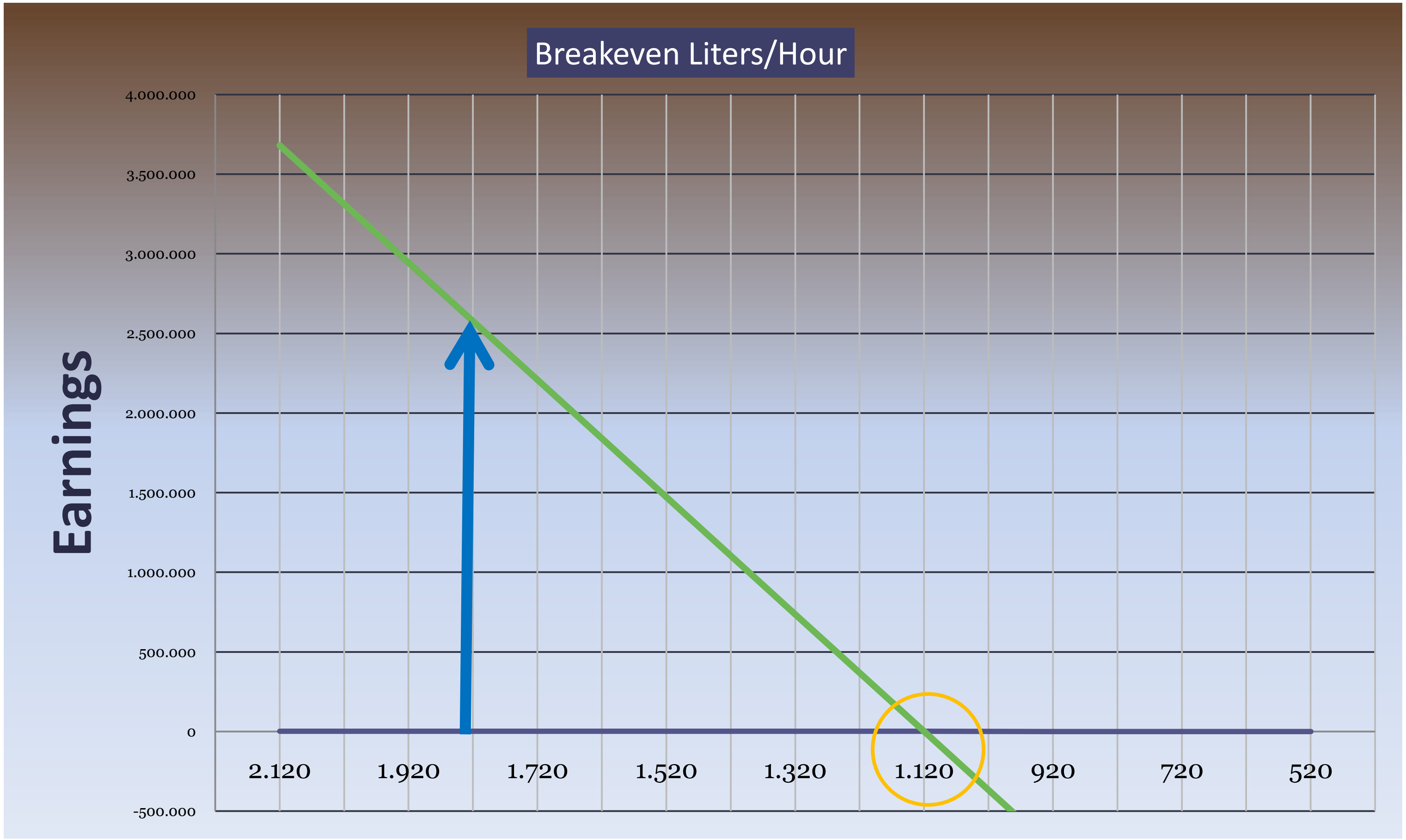
5.1 Break Even global

TRESORY/DEBT	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Incomes	6.624	6.624	6.624	6.624	6.624	6.624	6.624	6.624	6.624	6.624
Outcomes	4.363	4.380	4.398	4.417	4.438	4.459	4.482	4.506	4.531	4.558
Cash Flow period	2.261	2.244	2.226	2.207	2.186	2.165	2.142	2.118	2.093	2.066
Working capital	0									
Tresory	2.261	4.505	6.731	8.937	11.124	13.289	15.431	17.550	19.643	21.709
Long term loan Balance	11.933	10.884	9.775	8.601	7.360	6.048	4.660	3.193	1.641	0



5. ECONOMICAL FIGURES

5.2 Break Even per hour



Breakeven: 1,120 liters/hour (62% expected production)

APPENDICE A: CO2 CALCULATION

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Chemistry of this process:

Nature formed the petroleum in 2 steps:

-CO2-Exctraction from dead animals and plants to withdrawal the total oxygen content of the biomass and through that transfer or convert perishable matter to imperishable oils and

-Depolymerisation of long molecules to shorter molecules, also from Bitumen to Oils, Diesel and finally also to lighter hydrocarbons, like gasoline and natural gas.

The removal of the oxygen content in form of CO2 and not H2O, as it happens in thermal technical processes, is given through the low conversion temperature of the natural process. This is being realized in the complete temperature range during the formation of the petroleum till the conversion temperatures of the KDV technology which are below 300°C. Due to this process, not only complicated biological matter, as for instants the cellulose structure into Alkanstructure, transferred, but rather a hydrogen excess is produced, which is technically utilized in the KDV.

Cellulose can for example for the hydration of technical, unsaturated hydrocarbons, as technical oils, plastics and rubber deliver the nascent hydrogen after the reaction:

Cellulose + technical oils = saturated hydrocarbons, therefore 4 x $C_6H_{11}O_5$ (cellulose) + $C_{50}H_{92}$ (unsaturated technical oil) = 4 x $C_{16}H_{34}$ (diesel/kerosene) + 10 CO2S. this example from 1 ton celluloses + 1.06 tons of starkly unsaturated oils = 675 kg of CO_2 + 1,385 tons of high-value Alkandiesel shows the need for the input matter, namely

-for the feeding of technical waste from plastics, rubber and technical oils or oil wastes is the addition of nascent hydrogen from biomass necessary. There nature helps us because all biomasses in the KDV reaction releases more or less hydrogen.

-In feeding only biomass one gets a high great product of satiated hydrocarbons of the middle distillate area (shortly call diesel). The during this process produced hydrogen reacts with a part of the oxygen to reaction-water and the CO2 production is lesser for that amount.

APPENDICE A: CO2 CALCULATION

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The KDV reaction is therefore always

1. a diffusion catalytic new formation of the molecule structure
2. with the extract ions of the oxygen content as a CO_2,
3. adsorption of the molecular fine catalyst through Antransport with the catalyst oil at the brought hydrocarbon mass
4. without Koksablagerung
5. without Dehydrierung
6. without resin material development
7. in a continuous process
8. under development of satiated hydrocarbons
9. under avoidance of Olefinen
10. under avoidance of aromas and therewith the possibility of dioxin or Furanbildung
11. in the ion exchange removing of the acids halogens and sulfur and
12. regeneration of the catalyst with chalk

In the reaction steps of the KDV

1. entry systems
2. before process technology of the transformation of the festival materials into a pulp under complete draining ({PN200 - 220°PN}C)
3. KDV process with "friction turbine" under release of the hydrocarbons as a means distillate and the remaining CO2-Menge and
4. ash plant to the Limitierung of the salt salary and the not marketable inorganic materials in the KDV (metal, glass, ceramics, stones) and
5. in request after desulfurization (Hydrofiner)

APPENDICE A: CO2 CALCULATION

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Example cellulose:

KDV: C6H11O5 = 2 CO2S + 1 H2O + C4H9, therefore 163 kg of cellulose = 88 kg of CO2 + 18 kg of water + 57 kg of satiated hydrocarbons

Combustion of 57 kg KWS = 176 kg of CO2 + 81 kg of water,

therefore

1 t cellulose = 539 kg of CO2 (275 M3 CO2) + 111 kg of water + 350 kg of diesel

Combustion:
1 t cellulose = 1860 kg of CO2 (948 M3 CO2) + 610.5 kg of steam
KDV: 1 ton of cellulose + 1.06 rubber or strongly unsaturated oils = 675 kg of CO2 + 1,385 tons of Alkandiesel
combustion of this mixture: = 5,028 tons of CO2 + 1,781 tons of steam

Tabular comparison of KDV and Combustion:

Material	CO_2 KDV	Water KDV	CO_2 Combustion	Steam of Combustion
Cellulose	29 %	18 %	100 %	100 %
Cellulose + Rubber or Bitumen	13,4 %	0 %	100 %	100 %