STANDARDIZATION OF PURE VEGETABLE OIL (PVO) AS DIESEL FUEL

IFHVP - CEN - 2009/03/19

I.F.H.V.P.

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Norbert CASTAN

Vice-Président iFHVP

Président EPPOA

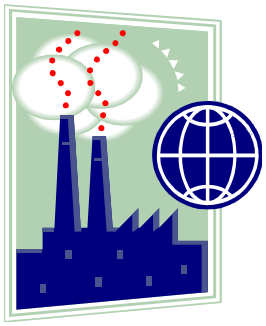
European Pure Plant Oil Association

Aim of the workshop

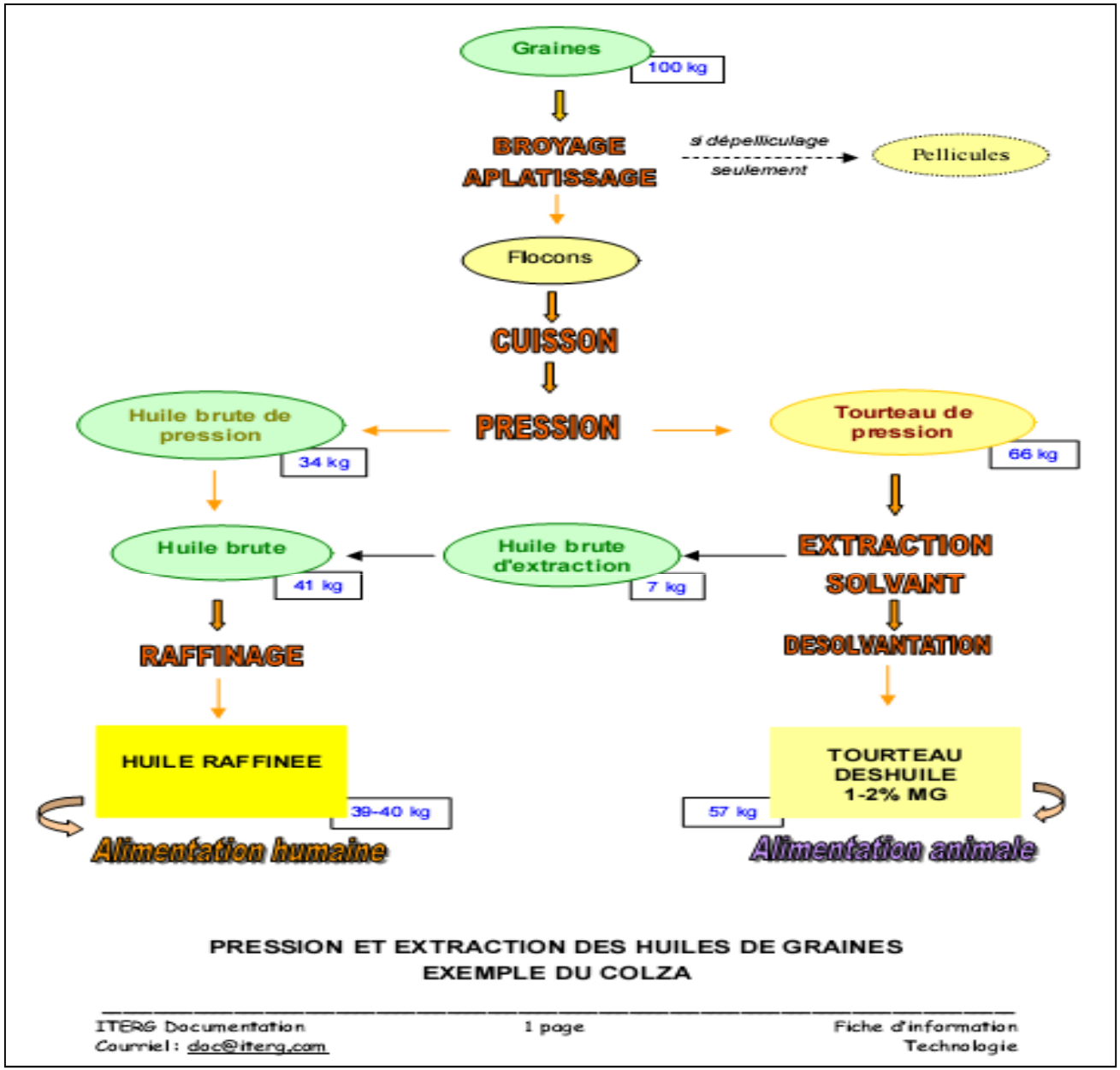
- To check for possibilities for standardization on a European level of pure oils
- To debate about hurdles encountered, problems solved and standard-type of documents needed to promote the application of pure oil fuel

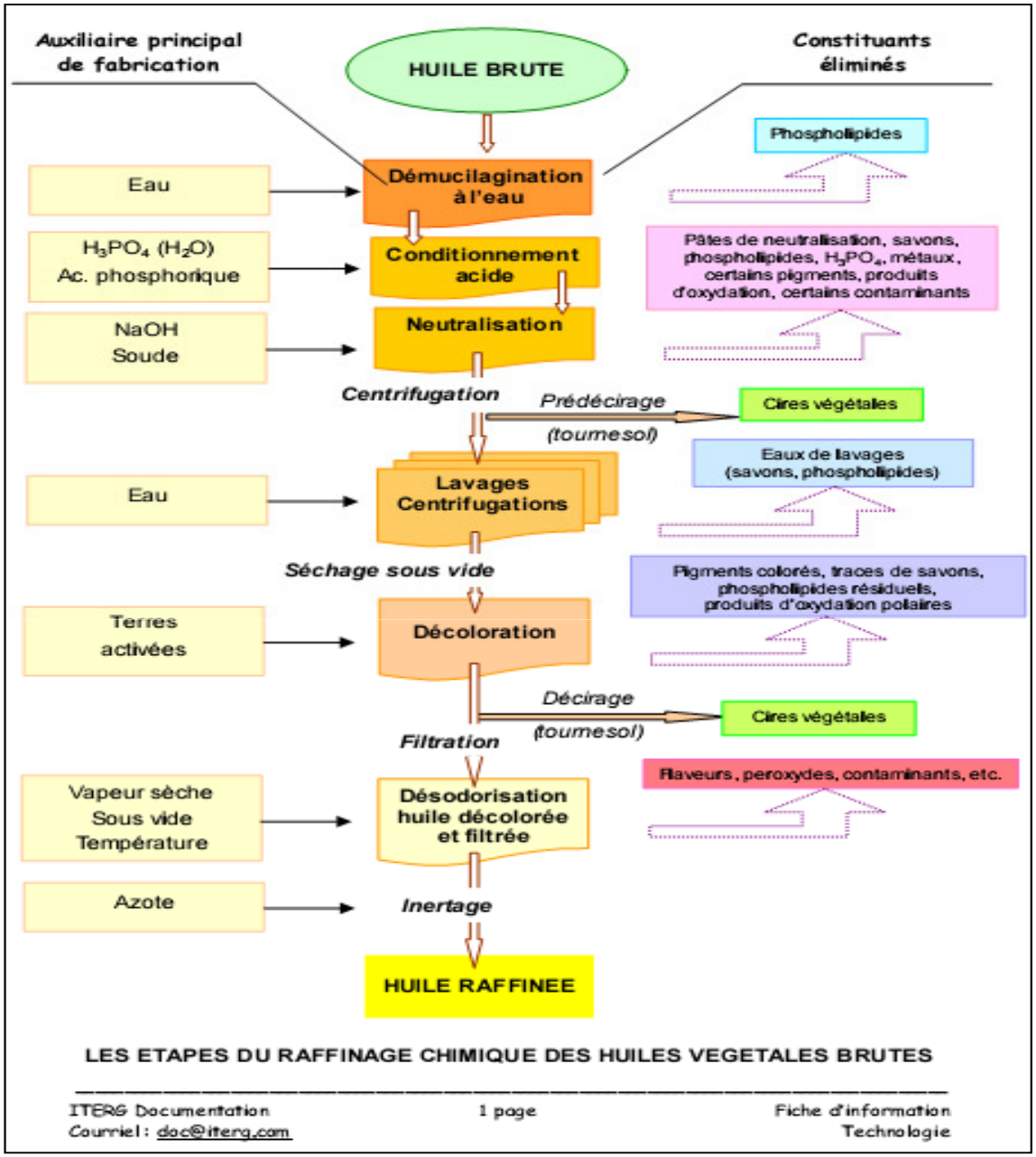
2 different ways to obtain Pure Vegetable Oils

1) oil extracted by industrial process



Very fast presentation


Graines
100 kg
BROYAGE
APLATISSAGE
si dépelliculage seulement
Pellicules
Flocons
CUISSON
PRESSION
Huile brute de pression
34 kg
Tourteau de pression
66 kg
Huile brute
41 kg
Huile brute d'extraction
7 kg
EXTRACTION SOLVANT
RAFFINAGE
DESOLVANTATION
HUILE RAFFINEE
39-40 kg
TOURTEAU DESHUILE 1-2% MG
57 kg
Alimentation humaine
Alimentation animale
PRESSION ET EXTRACTION DES HUILES DE GRAINES
EXEMPLE DU COLZA
ITERG Documentation
Courriel : doc@iterg.com
1 page
Fiche d'information
Technologie


Auxiliaire principal de fabrication
HUILE BRUTE
Constituants éliminés
Eau
Démucilagination à l'eau
Phospholipides
H_3PO_4 (H_2O) Ac. phosphorique
Conditionnement acide
Pâtes de neutralisation, savons, phospholipides, H_3PO_4, métaux, certains pigments, produits d'oxydation, certains contaminants
NaOH Soude
Neutralisation
Centrifugation
Prédécirage (tournesol)
Cires végétales
Eau
Lavages Centrifugations
Eaux de lavages (savons, phospholipides)
Séchage sous vide
Pigments colorés, traces de savons, phospholipides résiduels, produits d'oxydation polaires
Terres activées
Décoloration
Décirage (tournesol)
Cires végétales
Filtration
Flaveurs, peroxydes, contaminants, etc.
Vapeur sèche Sous vide Température
Désodorisation huile décolorée et filtrée
Azote
Inertage
HUILE RAFFINEE
LES ETAPES DU RAFFINAGE CHIMIQUE DES HUILES VEGETALES BRUTES
ITERG Documentation
Courriel : doc@iterg.com
1 page
Fiche d'information
Technologie

2 different ways to obtain Pure Vegetable Oils

2) **Decentralized**

hand-made

cold-first-pressing

Way of production : local energetic synergy

that's what IFHVP promotes

RAPSBIL.DK
EPPOA.ORG

Simple process - PPO as by-product

Decentralized hand-made cold-first-pressed Pure Vegetable Oil characteristics

- **Non-toxic** : no risk of inhaling toxic or carcinogenic gases, no risk of water pollution, no risk on skin contact
- Emissions = **ideal of less pollution** in converted vehicles
- **No sulphur emissions** : no risk of acid rain, soot discharges considerably reduced
- **Biodegradable, non-flammable**, no "vanishing into thin air"
- **Best energetic balance** ratio PVO to diesel = 6 : 1 (ADEME 2002)
- **Best GHG balance** ratio PVO to diesel = 1 : 7 (ADEME 2002)

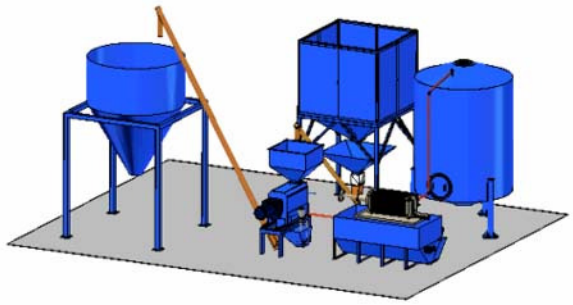
In order to don't mistake different Pure Vegetable Oils,

- IFHVP decided to call « **Veget-Ole ®** » the oil obtain by decentralized hand-made cold-first-pressing way of production.

- So « **Veget-Ole ®** » is a substitute of « gazole » (french term of diesel fossil fuel).

IFHVP promotion for V*eget-Ole®* protocol

- Nature friendly **agriculture methods**
- Cold-first-pressing only with **mechanical tools** and without solvents
- Careful **filtration** to obtain fuel quality
- Use of oil fuel in **converted vehicles**



Advantages expected by implementing IFHVP *Veget-Ole®* protocol

- Advantages for Environment and Nature (bees…)
- A few hundred km of transport avoided
- Oil locally suitable as fuel replacing fossil fuel
- Fat rich protein cake locally suitable for livestock feed replacing soybean cake
- Benefits for rural areas economy and social situation of farmers, country planning

Details STEP by STEP…

Step	What IFHVP promotes	Why	Advantages	Drawbacks
soil preparation	no ploughing, low pressure inflated tyres	let do micro life of superficial soil, don't compact soil	soil better for growing, less fuel consumption, work and expense	
growing	no chemical products	avoid grass by mechanical tool, let do natural predators	avoid chemical products, less pollution and expense	
harvest	leave straw on soil	self-manure of soil	no chemical manure needed	
oilseeds storage	in farm	for local transformation	avoid transport, keep harvest ownership	need a warehouse
pressing	cold-first-pressing by only mechanical tools	preserve natural characteristics of 2 products	non-toxic, easy, cheap, less long molecular chain	need tools , guidance documents and councils

Step	What IFHVP promotes	Why	Advantages	Drawbacks
oil using	replacing diesel fuel	no profit in France by replacing tractor-fuel	avoid transport, keep gains in rural areas, less fossil fuel imports	
cake using	replacing soybean cake	fat rich protein cake suitable for livestock feed (or natural manure)	traceability, keep gains in rural areas, less soybean cake imports	
oil storage and tank filling	dialysis and carefulness filtration	avoid molecular reformulation	oil suitable as fuel	
using oil as fuel	in converted vehicles	different of diesel : viscosity, flash point	best lubricant fuel, less pollutants, better couple and power, engine longevity	conversion legality and cost, engine warranty, oil supply

At European level, IFHVP propose to name oil obtained by decentralized hand-made cold-first-pressing as « VOLF » for Virgin Oil Liquid Fuel.

- **Virgin** = natural oil obtained only by mechanical cold-first-pressing process (whitout chemical product in any stage of production)
- **Liquid** = always liquid even at cold temperatures (e.g. rapeseed and sunflower oil), by cold-first-pressing and adapted filtration
- **Fuel** = suitable as fuel (conformity to Weihenstephan pre-norm)

Technical innovations, relevance And results

Frederic PERRIN

Engineer in Environment - Project Manager

Innovation and relevance

- German PVO norm DIN 51605 : limits of the analytical standards
  - Case of total contamination : EN 12662 (1998 : Methods of test for petroleum and its products. Liquid petroleum products. Determination of contamination in middle distillates) better for vegetable oil than the ISO 663.

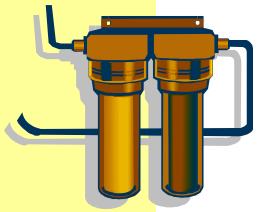
But : bad repetability, need to work on range of temperature and solvant quantity (viscosity)

Development of a special analytical standard for all type of VOLF (sunflower, Jatropha,…)

  - Case of water content (Karl Fischer method) : the content is so weak that the measure goes out of the device range

Innovation and relevance

- Consequences on process
  - ✓ conditions of sampling,
  - ✓ conditions of storage,
  - ✓ filtration efficiency : use of specific filtration medium
    - ✓ **Cut threshold**
    - ✓ **Determination of retention capacity**



- 2 work tracks:

- Global comprehension of production process

- Research on specific material for techniques of separation

Veget-Ole® for VOLF

- Why ?

  To guarantee the tracking and the product quality, for the producer and for the user

- How ?
  - ✓ determination of critical points on process : **cutting of the process by area**
  - ✓ audit on site (questionnaire), in the presence of the producer
  - ✓ VOLF analyzes on 4 essential parameters (2 analyzes per year)

  - Water content,
  - Phosphorus content,
  - Acidity value (TAN)
  - Total contamination

  } **reference to the DIN 51605**

- Main points on results :
  - Enclosed space : not necessarily set up
  - techniques of separation and filtration quality

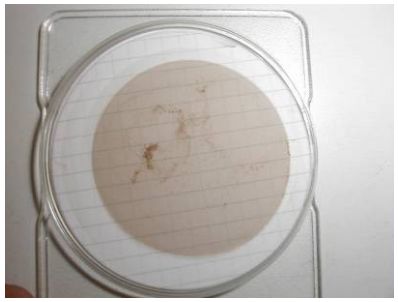
LANDTECHNIK WEIHENSTEPHAN	**LTV-Work-Session on Decentral Vegetable Oil Production, Weihenstephan** **Quality Standard for Rapeseed Oil as a Fuel (RK-Qualitätsstandard)** 05/2000	in Cooperation with:

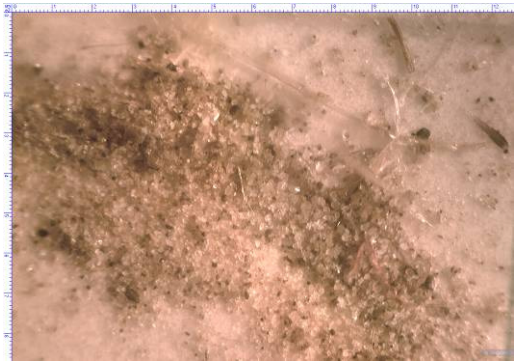
Properties / Contents	Unit	Limiting Value		Testing Method
		min.	max.	
charcteristic properties for Rapeseed Oil				
Density (15 °C)	kg/m³	900	930	DIN EN ISO 3675 DIN EN ISO 12185
Flash Point by P.-M.	°C	220		DIN EN 22719
Calorific Value	kJ/kg	35000		DIN 51900-3
Kinematic Viscosity (40 °C)	mm²/s		38	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
variable properties				
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

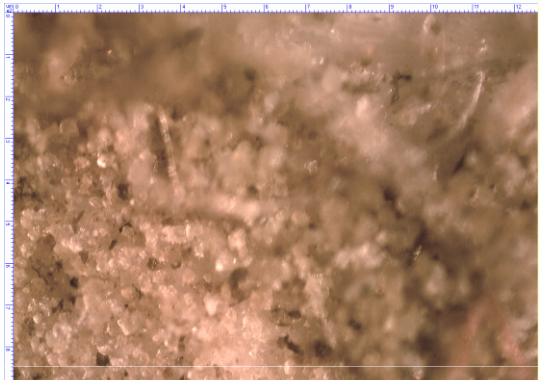
00 1ER 100e

Filtration threshold : results on sunflower VOLF

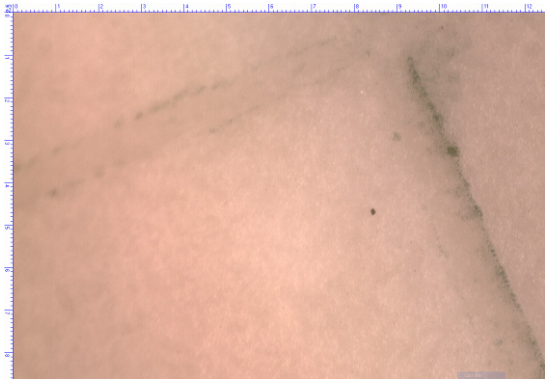
Clarification 3 months - Barrel Press – sampling of 100 cm^3

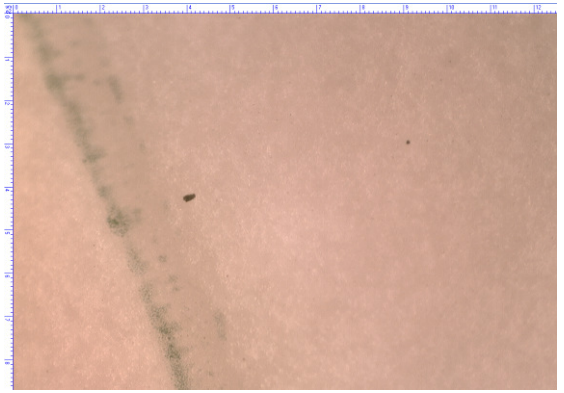






After filtration 2µm abs – retention capacity of 125 g – 1 pass





IFHVP Development in France with districts

Communauté de Communes du Villeneuvois (47) :

- ✓ Running on VOLF (sunflower) since nov. 2005
- ✓ **10 refuse lorries** ***(the worst conditions for engines!)***
  - ✓ 4 on HP injection (DCI) running on 30% VOLF
  - ✓ 5 direct injection models converted (2-tank system) running on 100% VOLF
- ➢ VOLF from Végétole® producers

Between november 2005 and november 2007, on 10 refuse lorries :

- **100 517** liters of consummate diesel fuel,
- **125 824** liters of consummate PVO,
- **359 443** km covered

IFHVP Development in France

Communauté de Communes du Val de Garonne (47):

- Running on VOLF (sunflower) since jan. 2008
- **10 trucks** with 30% VOLF : 6 lorries and 4 vans
- VOLF from one Végétole® producer

EARL Gourgues

During 2008 :

- **18 900** liters of consummate diesel fuel,
- **8 100** liters of consummate VOLF,
- **118 000** km covered

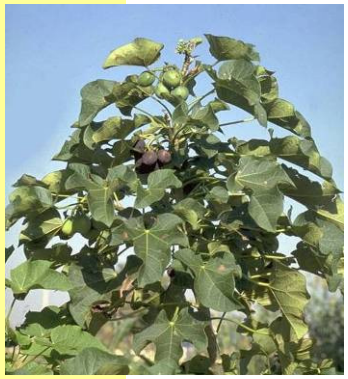
IFHVP Development in France

Communauté of Montauban Trois Rivières (82) :

- Running on VOLF (sunflower) since oct. 2008
- **31 vehicles** with 5, 15 or 30% VOLF (according to engine guarantees)
- VOLF from one Végétole® producer

Cuma BioEnergies 82

International IFHVP Development



- **Madagascar**
  - Study in 2007/2008
  - project of usage of vegetable oil of Jatropha for the rail traction
  - Goal = local energetic diversification and social development alongside the rail

- **Senegal**
  - local energetic diversification with VOLF from Jatropha and food farming
  - Work on plastic recycling (HORTIS)
  - Partnerships with the ISRA (Senegalese Institut for agricultural research) and a local association (DiaspoReva)
  - Project envolved in the REVA program

Results of using VOLF

- ***Végétole®*** results

		Total contamination (ppm)	Water content (ppm)	TAN (mg KOH/g)	Phosphorus (ppm)
DIN 51605		24	750	2	12
CCV (47)	GAEC de Lustrac	13	464	1.04	9
	GAEC La Forêt	6	435	0.93	4
CCVG (47)	EARL Gourgues	20	655	0.36	0
Montauban (82)	Cuma Bioenergies 82	22.7	490	1.37	4

Even if some results are at the threshold of the DIN 51605, it must be considered that :

-by knowing exactly the process line, **suitable conditions and materials would be advocated (e.g. special filtration from 5 to 2 µm abs),**

- By knowing exactly the **human parameter**, some results as total contamination would be explained and not all product would be classified as "Not fuel Quality"

Results of using VOLF

- ***Végétole®*** tracks :
  - ✓ Sensitization of producers to quality factors
  - ✓ Use of specific filtration regarding :
    - ✓ Economic costs
    - ✓ capacity of treatment : volume treated per cartridge
    - ✓ threshold of residual contamination

According to the ACEA Worldwide Fuel Charter :

- Contamination : 10 ppm (EN590 : 24 ppm),
- Particules counting : **ISO 4406 = 18/16/13** (none for EN590)

Test of filtration (1 pass on 2 µm abs Hydac® – rapeseed oil – clarification 6 months) : Particule counting : **ISO 4406 = 16/14/10**

Technical results on vehicles

Case of CCV : expertise by CIRAD (10/17/2008)

- Endoscopy of engines running on 30% and 100% VOLF,
- Dismantling of one cylinder after 1000 hours working, 25 000 l VOLF consummate, since nov. 2005 :

No premature wear

"Some deposits are visible, in particular on the admission valve, in proportions not very important. One meets this deposit type in the motors to pure diesel fuel. Only shininess could indicate us a usage in PVO. A quotation motor would have given assuredly a close grade of 10/10. "

Technical results on vehicles

In global (for all districts running on VOLF in France):

- ✓ No engine broken,
- ✓ No power loss,
- ✓ Less pollution,
- ✓ Good behaviour of vehicle

Pollution controls

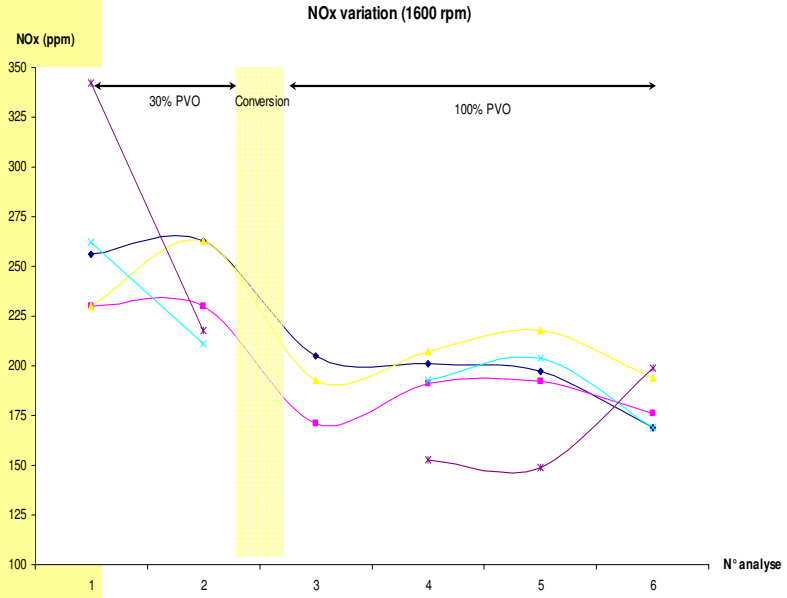
- Comparatives studies of the pollutant load between vehicles running on pure diesel fuel and vehicles running with VOLF (30% or 100%).
- Special case of analyse : no engine load, 2 speeds.
- Measure of quality load, not quantity of pollutants : **do not compare with European emission standards**

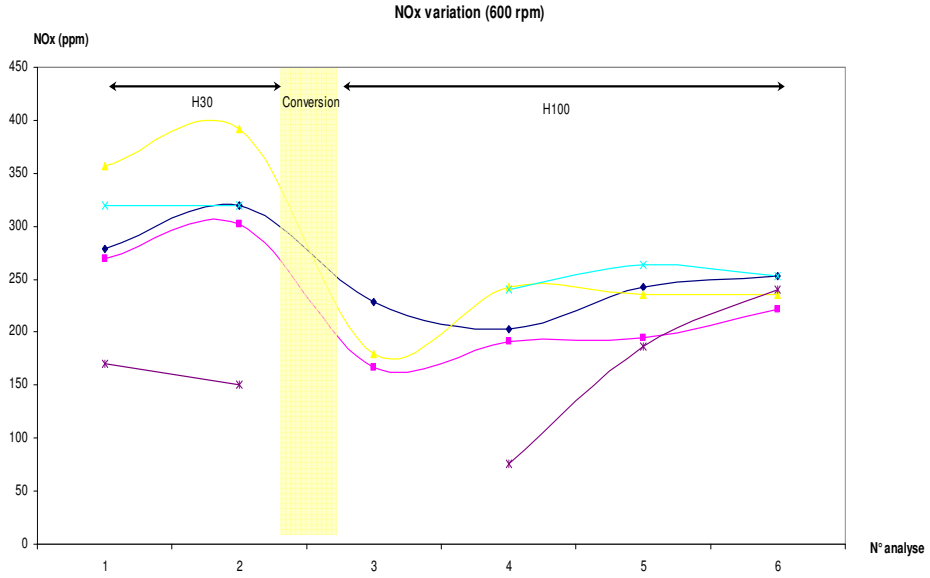
Average results :

Average gap		CO	CO_2	HC	NO_x	Opacity
100% PVO (CCV)	Min	- 22%	-1.4%	+ 2.6%	- 3.5%	- 29 %
	Max	- 25%	+ 3%	+ 9%	+ 1.5%	
30% PVO (CCVG)	Min	- 7%	0%	- 25%	- 56%	- 4.2%
	max	+ 33%	- 33%	+ 600%	+ 33%	- 71,4%

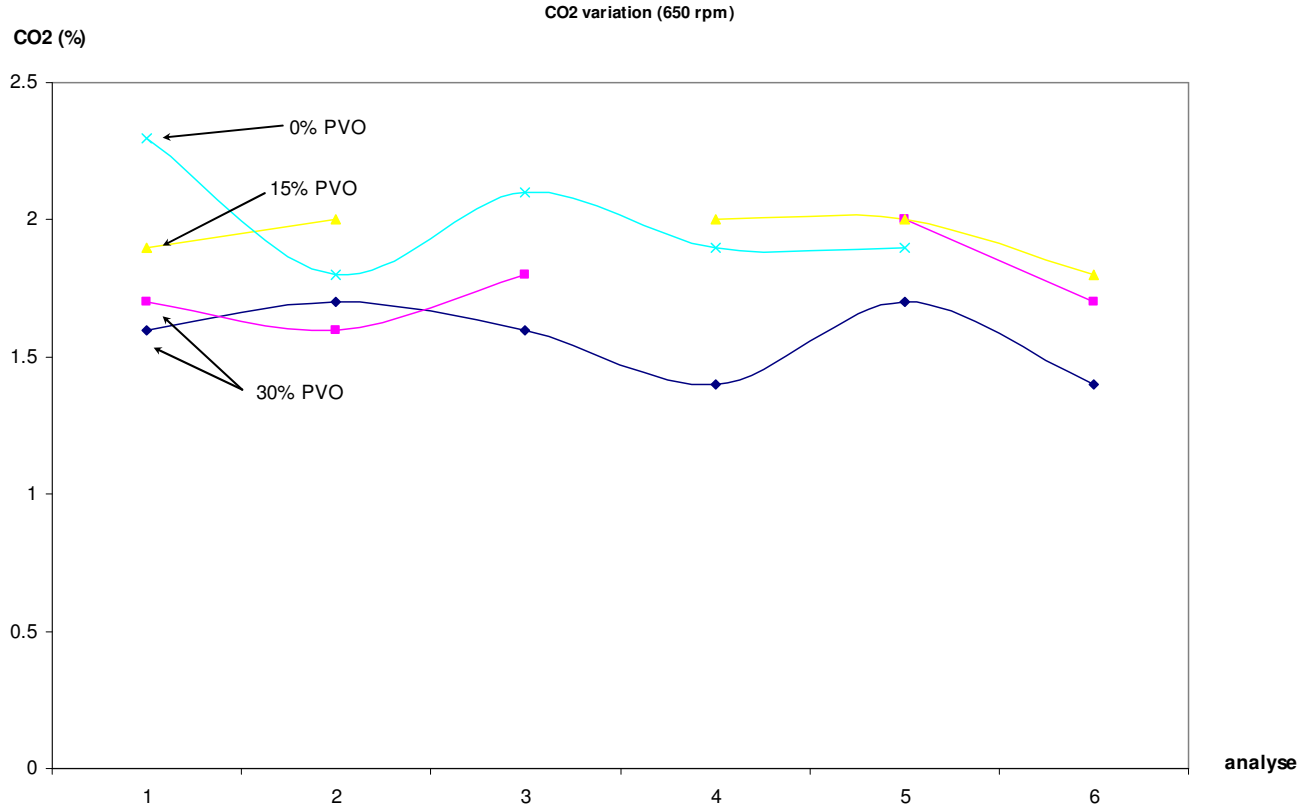
Pollution controls

Case of CCV : NO_x variation between 30% and 100% VOLF





CO_2 variation on HP injection



Engine models : Renault DCI 270

Energy and Carbon balances

	Fuel	Rapeseed Biodiesel	Sunflower biodiesel	Rapeseed oil	Sunflower oil
Returned energy / fossil energy mobilized	0,917	2,99	3,16	5,45	6,33

	Fuel	Rapeseed Biodiesel	Sunflower biodiesel	Rapeseed oil	Sunflower oil
GHG (g eq. CO_2/kg)	3394	888	745	660	498

From Ecobilan ADEME/DIREM/PHWC 2002

The district of Montauban has estimated that by using 30% of VOLF in 30 vehicles during 1 year, **150 tons of CO_2 would be saved.**

BILAN CARBONE

calculating both balances regarding to :

Cultural routes - Short scale process lines - Direct use

Hurdles encountered
and
what IFHVP expected
from European Commission
in order to really uptake VOLF

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Matter	It should be	Why	Advantages	Drawbacks
oil fuel standard	based on VOLF properties, don't try to get diesel characteristics	keep 100% natural product	promote VOLF in farm 100% natural production	***NO MORE BARRIER FOR FARMER !***
engine makers	"flex-fuel" diesel-VOLF	avoid oil supply difficulties, less conversion expense	less cost because of large scale production, engine warranty	R&D cost
legality	free to use VOLF in car, trucks, etc. all over EC	still forbidden in France (because of compatibility clause?)	End of discrimination in comparison with PVO in Germany and with Diester®	
taxation excise duty	VOLF free of excise duty all over EC	VOLF best biofuel	kill a real barrier to uptake, less aids to farmers required	

Matter	It should be	Why	Advantages	Drawbacks
taxation VAT	agricultural reduce rate	full VAT rate in France	avoid distortion all over EC	
R&D subsidiaries	subsidiaries harmonized between all biofuels	french excise duty covered special tax for IFP owner of Diester® patent	R&D (standardization, GHG reduce calculation) information and advices to farmers/users	
Councils to producers and users	European guidance documents and official VOLF advisors (EPPOA is a wealth of that kind!)	Difficult to get good an complete information needed Most of volunteers through Europe (not yet VOLF lobby!)	Insure oil quality for both farmers and users benefits	Budget for VOLF advisors expertise
VOLF uptake	implementation of legal and fiscal quoted measures	avoid discrimination and distortions, do promotion of VOLF	get a great and real progress in sustainable development all over EC	

To conclude : be pragmatic…

- **An oil quality standard (Weihenstephan)**

Base on VOLF characteristics,

- **A specific VOLF pollutants standard**

Lift some limits

- **New contamination measurement standard**
- **Guidance documents**

For farmers and users

- **Public founds for really involved advisors (*)**

(*) from non-profit organization which aims quote clearly VOLF

…and don't deceive farmers!

- Farmers : " a standardization, what's for ? "

- IFHVP : " standardization is a step for VOLF promotion, and we will tell to European Commission that all other steps (engine aptitude, legality, taxation, R&D, guidance documents and putting in place advisors) should be started at the same time. "

- Farmers : " Otherwise it doesn't worth ! "

Now farmers trust in our collective work to banish all hurdles we encounter today. Thank you to don't deceive them !

Institut Français des Huiles Végétales Pures

« From Will to Well » *« De la Volonté au Bien »*

Member of « European Pure Plant Oil Association »