IENICA

SUMMARY REPORT FOR EUROPEAN UNION

OIL CROPS

4.0 OIL CROPS

4.1 Scientific and technological aspects

The world production of vegetable oils is detailed in Table 4.1. Of these sources European production is dominated by oilseed rape in most northern Europe and Sunflower in central and southern European countries (See table 4.2). Except for High Erucic Oilseed rape cultivars, these crops are principally grown for food uses, but a significant proportion is used in non-food applications. Soya bean cultivation is increasing in southern Europe, but little is currently utilised in non-food products. Linseed is a traditional species of northern Europe with non-food application, its area fluctuates and is largely subsidy driven. To supplement European production considerable quantities of oilseeds, particularly tropical oilseeds, are imported.

Considerable scientific activity has taken place in many European countries, funded by National Governments and EU, to support and develop new oil crop species. Table 2 lists 19 species which have been shown to produce oils containing interesting specific fatty acid profiles, but most are wild species that have major cultivation problems and/or marginal oil production potential. The species identified offer a considerable diversity and oil characteristics but significant further investigation will be necessary to refine and quantify specific commercial opportunities and develop field productive types. Pilot production studies will be an essential pre-requisite to achieve full commercialisation. Currently only two species appear to be moving towards commercialisation, Crambe and Pot Marigold.

In an alternative approach effort is being directed towards the modification of the oil composition of existing crops, particularly using gene transfer. High oleic sunflower has been commercialised, high oleic and high lauric rape have been produced but not yet commercialised.

Table 4.1 : Calculated world production of selected vegetable oils (million tonnes)

	1970	**1980**	**1990**	**2000***
Castor	0.4	0.5	0.5	0.8
Coconut	2.4	3.2	3.0	4.0
Cottonseed	2.5	3.2	4.0	4.0
Groundnut	3.0	3.2	4.0	4.0
Linseed	1.0	1.0	1.0	1.0
Olive	2.0	2.0	2.0	2.5
Palm**	2.0	4.5	13.0	22.0
Rape	2.0	4.0	9.0	15.0
Safflower	0.2	0.3	0.3	0.3
Sesame	1.0	1.0	1.0	1.0
Soya	6.0	15.0	16.0	30.0
Sunflower	2.0	4.0	8.0	12.0
Subtotal	24.5	41.9	61.8	96.6
‘World total (all vegetable oils)	35.00	60.00	80.00	102.00

*Estimate **Palm and palm kernel oil
(Source: Oilseed Crops, A E Weiss, 2000)

Table 4.2 : Oil Crops by Species and Country

Oil Crop	Austria	Belgium	Denmark	Finland	France	Germany	Greece	Italy	Ireland	Netherlands	Portugal	Spain	Sweden	UK
Commercial Species														
Brassica napus/B. campetris	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓ C	✓
Brassica napus/B. campetris (HE)					✓	✓		✓		✓				✓
Castor								✓ P						
Crambe	✓	✓	✓		✓	✓ P		✓ P		✓ P	✓		✓	✓
Linseed		✓	✓	✓	✓	✓		✓		✓		✓	✓	✓
Poppy	✓ C													
Safflower								✓ P						
Soya bean	✓				✓			✓						✓
Sunflower	✓				✓	✓	✓	✓		✓		✓		✓ P
Oil pumpkin	✓ C													
Development Species														
Calendula		✓	✓			✓				✓				✓
Camelina	✓	✓	✓	✓	✓	✓		✓		✓		✓		✓
Coriander			✓			✓		✓		✓				✓
Crepis			✓							✓				
Cuphea								✓		✓				
Dimorphotheca		✓	✓							✓				✓
Lallemantia iberica						✓								
Eruca								✓		✓				
Euphorbia					✓	✓		✓		✓		✓		✓
Hemp oil	✓													
Lesquerella spp		✓						✓		✓				✓
Limnanthes spp		✓	✓					✓		✓				✓
Lunaria								✓		✓				✓
Madia								✓						
Vernonia								✓						
Brassica carinata								✓						
White mustard								✓				✓ P	✓	

'**C**' denotes commercial production and 'P' denotes at pilot stage/small area. '✓' denotes scientific interest/development.

Table 4.3 EU 15 Usage of European produced vegetable oils in technical/chemical industries

Crop	Quantity oil (000t) 1998	Quantity oil (000t) 2004
Rapeseed	265	350*
Sunflower	63	63
High oleic sunflower	7	}
High oleic rapeseed		}35***
Linseed	60	55
High erucic rapeseed	56	79**
Total	460	582

Assumptions:-
* 5% annual growth in demand
** 4% annual growth in demand
*** current demand assumes that supplies will be available
Source: Sylvain (1999)

4.2 Markets

Most European countries have oilseed crushing and refining facilities, for full details see individual country reports. The established crusher companies are generally crushing imported oilseeds, particularly tropical oilseeds and soya bean, as well as local products. Crushing/refining technology is generally well developed but new investigations are in progress to identify more environmentally friendly and cost effective extraction technology.

Currently European vegetable oils form one of a large range of alternative raw material products. Oil purchases are made on the basis of availability, raw material price, manufacturing costs and utilisation potential and quality parameters. Vegetable oils from established crop species have few specific quality advantages over mineral oils and are generally more expensive. They therefore have to find or develop specific markets where their intrinsic properties can be fully realised. Introducing new crops and oils is especially difficult because of lack of volume and the conservative nature of the industry. Only crops producing oils with very special attributes are likely to succeed.

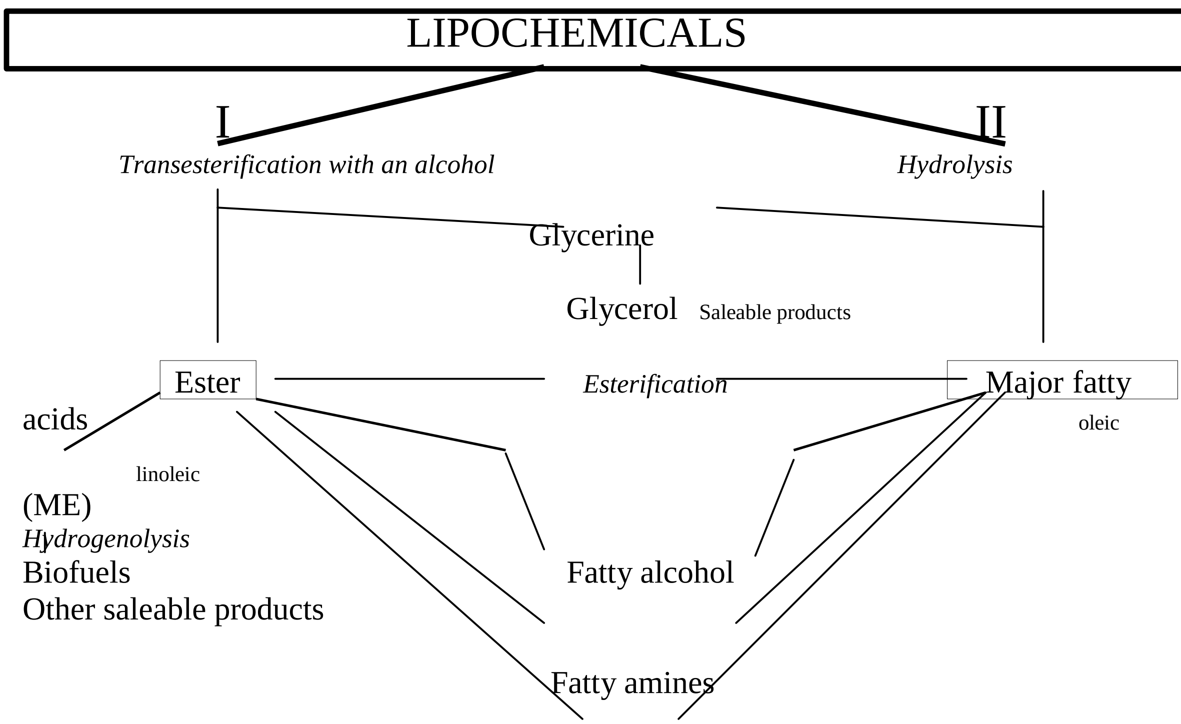
In technological terms, the potential for utilising vegetable oils derived from traditional processes is well proven and diverse. The diagram below outlines the processes for conversion of oils into oleochemical products using two treatment pathways. A full flow chart indicating potential for modifying triglycerides is shown at Annex 20 and specific examples using Ricinus at Figure 4.1.

Figure 4.1 : Processing Potential for Ricinoleic Acid ExCastor

CASTOR OIL		coating, artificial leather, flashing agent for pigment, dieletrics, polyurethane, factice, process aid of rubber, lubricant, brake, fluid, medicine, cosmetics, office requisite
Pyrolysis	Heptaldehyde Heptanoic Acid	synthetic lubricant, esters for food, synthetic perfume
	Undecylenic Acid	11-nylon, fungicide, synthetic perfume
Caustic Fusion	Octanol-2	synthetic lubricant, synthetic perfume
	Sebacic Acid	6.10-nylon, alkyd resin, polyester resin, plasticizer, hardener for epoxy resin, rust inhibitor, synthetic lubricant, synthetic perfume
Oxydative Polymerisation	Blown Castor Oil	plasticizer, caulking material, adhesive
Hydrogenation	Hydrogenated Oil 12-Hydroxytearic Acid	lubricating grease, paint additive, lubricant for plastics, crayon, wax compound, polish, cosmetics, medicine
Urethane Reaction	Polyurethane	potting and encapsulating material for electrical insulation, structural adhesive, flooring, elastomer sealant, water proofing material
Saponification Acidulation	Ricinoleic acid Castor oil fatty acid	stabiliser for PVC, duplicating paper, alkyd resin, surfactant. Food esters.
Dehydration	DCO DCO fatty acid Maleinised DCO	baking enamel for metal (nonaquous, aquous type), durable rapid dry coating, insulating varnish, printing ink, caulking material
Sulfation	Turkey red oil	dyeing aid, metal working oil, fat liquer for leather, textile oil, emulsifier for agricultural chemicals
Sodium reduction	Ricinoleyl alcohol	cosmetics, surfactants
Esterification	Esters of hydroxy acid	synthetic lubricant, metal working oil, textile oil, plastizer, cosmetics, brake fluid, dispersant for pigment and dye
Halogenation	Halogenized oil	inflammable intermediate (polyurethane)
Alkoxylation	EO/PO Adducts	surfactant, synthetic lubricant, metal working oil, polyurethane

Source: Le Ricin, Alain Bonjean, ONIDOL.

Triglycerides (98 %): Glycerol + fatty acids (90 % MM TG)



OLEOCHEMICAL CONVERSION

Principal conversions	Desired result	Example of area of application
Hydrogenation	Saturation	Improving viscosity of **lubricants**
Fractionated distillation	Separation of carbon chains of different lengths	**Surfactants:** • long chains = emulsifiers, softeners • short chains = wetting agents, detergents
Crystallisation	Separation solid fraction: saturated fatty acids = stearine liquid fraction: unsaturated fatty acids = oleine	➢➢**} Soaps** ➢➢**} Formulation for paints and varnishes**

Estimates for EU-15 showed an overall non-fossil oil usage in the non-food sector to be 2.5 to 3 million tonnes per annum. This accounts for approximately 15 to 20% of total non-fossil oil use in EU15. A summary from FEDIOL, the umbrella oilseeds organisation is given at Annex 2.

From data derived during 1997, the tonnage of vegetable oils was used in 4 primary market areas was:

- Lubricants : 2%
- Paints and surface coatings : 8%
- Surfactants/soaps/various : 31%
- Oleochemicals : 59%

There is considerable potential to expand EU produced vegetable oils use in these markets, in principle upon a basis of import substitution alone, when currently less than 20% is used from EU sources; approximately 80% of current supplies are based upon imported tallows of animal origin or imported tropical vegetable oils. The analysis of this imported fraction is circa 55% tallow and 45% vegetable oils.

Whilst the foregoing represent significant opportunities, it must be noted that the oils industry has stated quite clearly that it has no interest in non-competitive materials.

4.2.1 Soap/surfactant/detergent markets

Surfactants act as setting agents or emulsifying or softening agents and have a wide and diverse range of uses. The essence of a surfactant is one of creating surface linkage through hydrophilic or hydrophobic functionality. Their production is dominated by tallow from livestock and palm kernel oil, both sources of C12 oils.

Surfactants possess different ionic and hydrophobic characteristics, depending on the type of processing used, giving them properties that can be tailored to specific needs. Accordingly, vegetable-based surfactants can replace a broad spectrum of fossil-derived surfactants. Generally speaking, surfactants fall into four categories, by degree of ionicity, as outlined in table 4.4.

Table 4.4 : Surfactants

Category	*Example of compound*	*Comment*
Anionic	• Sulphonated alpha methyl esters	Detergents to replace petrochemical alkylbenzene sulphonates
Non-ionic	• Ethoxylated fatty alcohols** • Alkylpolyglucosides	Share of global surfactants market rising very rapidly.
Cationic	• Fatty amine salts • Quaternary amine salts*	
Amphoteric	• Betaines	Foaming, anionic or cationic depending on the pH of the solution.

* Being removed in EU-15. Replaced by ester alternatives.
** Current views in the market place are that these will be replaced by synthetics.

There are many ways to obtain surfactants; in this regard is important to note that the fatty acids used to obtain surfactants from oilseed products determine the final characteristics of the hydrophobic component of the final product:

C12-C14 short-chain fatty acids (lauric acid, myristic acid) are suited to wetting and detergent applications, C16-C22 long chains are suitable for use in emulsifying and softening solutions.

Controlled foaming detergents are obtained by hydrogenation of erucic acid (producing behenic acid). Surface agents are derived directly from fatty acids, methyl esters of fatty acids, fatty derivatives (ethoxylates, sulphates) or fatty amines.

New processes have recently emerged that associate a hydrophobic component made up of fatty alcohols with a hydrophilic component derived from by-products of starch and sugar processing (wheat bran and straw, beet pulp). Using these processes, compounds that are doubly natural (alkylpolyglucosides) can be obtained; these products are very well tolerated by the skin compared with fossil-derived surfactant, and are particularly promising for applications in cosmetics, where their higher cost is not limiting.

The diversification and expansion of surfactant markets provides an incentive for the broad range of research now being conducted, aimed at developing economically profitable processing techniques and tailoring quality to the specific needs for each type of application.

Markets for surfactants are large and likely to increase, particularly if tallow use declines. Total EU consumption in 1998 of non-soap surfactants amounted to more than 2 million tonnes and 0.9 million tonnes of soap detergents. According to French data (ARD), the largest single component of detergents use in EU is in domestic household (up to 1.5 million tpa by 2005), with other significant users being formulation of plastomers and elastomers (up to 180,000 tpa by 2005) and cosmetics (up to 195,000 tpa by 2005).

However, the inability of EU agriculture to produce short-chain plant-derived fatty acids like lauric acid needs will be severely constraining, unless some economically sound and environmentally acceptable scientific breakthrough occurs, such as the development of plant species like *Cuphea*, or the transfer of genes from *Cuphea* to commonly grown oleaginous crops. However, the competitive pricing of palm kernel oil production would be a particular challenge to EU farmers.

Price competitiveness and consumer appeal are key factors in exploiting the expanded potential markets that are listed above. Each sub-section has its own economic elasticities, that for cosmetics being most elastic and therefore being suited to many higher-priced plant products produced in EU.
Surfactants are used in a great many applications, notably in cosmetics, household and industrial detergents, pharmaceuticals. To a lesser extent, they are used in paper-making, construction materials and plastics.

4.2.2 Lubricants

Table 4.5: Size of Lubricant Markets, based on 1993 data

Country	Lubricants Market (kt)
Austria	86.1
Belgium	218.8
Denmark	77.8
Finland	93.0
France	890.5
Germany	1,164.8
Greece	122.0
Ireland	40.0
Italy	780.0
Luxembourg	10.0
Netherlands	274.8
Norway	82.7
Portugal	103.3
Spain	358.0
Sweden	141.5
Switzerland	69.3
United Kingdon	806.1
TOTAL	5,319

The European lubricants market totals 5.3 million tonnes per annum (see table 4.5) and can be divided up as follows:

- 2.5 million tonnes of vehicle lubricants (47%)
- 2.3 million tonnes of industrial lubricants (43%)
- 0.5 million tonnes of marine and aviation lubricants (10%)

The total European market for drilling oils/muds amounts to 80,000 tpa.

Vegetable oils have good environmental characteristics. They are inherently biodegradable, of low ecotoxicity and toxicity towards humans, derived from renewable resources, and have no net carbon dioxide contribution to the atmosphere. It is not surprising therefore that considerable efforts have been directed towards using them in designing environmental fuels and lubricants. These efforts by the petrochemical industry have been widely publicised over recent years.

However the use of vegetable oils as lubricant base oils is restricted by some technical disadvantages constraining their use particularly at high and/or low temperature. Very high oleic oils seem to offer the best compromise in terms of technical characteristics. As a result genetically-modified high oleic sunflower oils and high oleic rapeseed are beginning to find uses where higher oxidative stability is required.

Much has already been achieved in fulfilling the technical needs of specific applications but technical challenges remain to expand specifications using new sources of vegetable oils and increase usage.

Exploitation of vegetable oil derivatives for the lubricant sector will offer specific performance characteristics:

- already approved by original equipment manufacturers (OEMs);
- environmentally benign, especially in total-loss systems;
- user-friendly;

Market opportunities already exist particularly where high environmental contamination occurs;

- chainsaw oils (eg rapeseed oil);
- hydraulic fluids using oils and esters (eg the Tekniker-developed sunflower products for earth moving equipment in Spain);
- drilling oils/drilling muds (eg rapeseed esters);
- oils for use in the concrete construction industry
- cutting oils (eg as esters), which have specific health benefits.

Table 4.6 The Potential European Market for Biodegradable Lubricants.

	Total market for Lubricants (‘000 Tonnes)	Current European (‘000 Tonnes)	Potential European (‘000 Tonnes)	Value of Potential Market (£ Million)
Antiwear Hydraulic	610	20	250	825
Grease	90	0.6	35	58
Chainbar	40	10	40	66
Mould Release	40	2.5	30	50
Two Cycle	70	1	3	10
Anti-corrosion	25	0.6	7.5	12
Others	0	0.6	3	5
TOTAL	**875**	**35.3**	**368.5**	**1,026**

Source: Lubrizol

The current and potential European market for biodegradable lubricants is given in table 4.6. Of the current usage 25,000mt is used exclusively in Germany (Source: S Harold, Lubrizol).

Lubricant quality of vegetable oils can be enhanced by further chemical processing, including changes in triglyceride structures or production of fatty acids and esters. In summary, bio-oils have considerable benefits:

- Oleochemicals absorb on metallic surfaces and create an anti-friction layer. This advantage is currently in the formulation of diesel fuel for passenger cars.

- In the formulation of lubricants, the use of oleochemicals will reduce the friction between the parts in movement and the related wear. This anti-wear performance is used in the formulation of chainsaw oils, compressor oils, hydraulic fluids, engine oils, greases, etc and wear reduction of 50% has been reported. This contributes to a longer service life of the machines and materials.

- The chemical structure of some saturated oleochemicals will increase the oxidation stability far above these of corresponding mineral oil based products. This allows extended drain intervals according to specifications and approvals of original equipment manufacturers. This reduces costs of maintenance.

- The natural detergency and dispersancy of oleochemical esters will keep systems clean. In diesel engine oils, oleochemical esters will reduce the oil thickening related to the presence of soot particulate. This contributes to the development of engine oils with drain interval up to 160,000 km (according to Mercedes-Benz specification MB 228.5).

- The high solvent character of oleochemical esters will allow some new solvent formulations, replacing halogenated hydrocarbons, ketones, aromatics and other strong polar petrochemicals.

- The low volatility of oleochemical esters will be an additional advantage to substitute solvents when the proposed European Directive on Volatile Organic Compounds becomes effective.

- The adhesive character of oleochemical derivatives is an important advantage in the formation of performing greases.

- The natural high viscosity index (multigrade character) of vegetable oils and their oleochemical derivatives is also an additional advantage in the formation of lubricating oils and fluids.

- The natural and harmless character of oleochemical derivatives is particularly significant when problems of skin irritation in humans reported (dermatitis, eczema).

- The reduced flammability of oleochemicals derivatives could reduce fire risks and through that insurance premiums and therefore overall operational costs.

- Oleochemicals are generally biodegradable.

The drivers for adoption of vegetable-oil-derived lubricants are:

- Regulatory issues
- Price
- Performance
- Need or wish to change sourcing to renewables
- Environmental impact and image
- Contract specifications (eg EU tenders)

It is the last two factors, which will have the greatest effect especially if 'the polluter pays' principle and life cycle analysis criteria are taken into account. However, fluctuations in supply of primary raw material will reduce confidence in the processing sector. Hence, some stabilising mechanism to ensure adequate supply is essential.

Evidence indicates that a number of major players in lubricants markets have prepared vegetable-oil-derived substances as substitutes for current fossil petrochemical derived lubricants. IENICA partners have identified the following companies as having interests:

- Fuchs
- Shell/BP
- Elf Aquitaine/Total/Fina
- Lubrizol International
- Novance
- Castrol
- OMV

However many are focusing on use of tropical oils rather than European produced oils.

4.2.3 Paints and surface coatings

Vegetable oils are currently used in the manufacture of:

- gloss (oil-based) paints
- oil modified alkyl resins which form reticulated films with variable drying times and have many paint and varnish applications. Quick-drying alkyde urethanes are derivatives with a promising future.
- oleoresinous varnishes
- printing inks as 'vehicles' in lithographic, letterpress and thermally polymerised inks.

- Slip agents. Production of erucamide from high erucic rapeseed oil is well established.

The majority of oil modified resins are based on soya oil, although recently sunflower, which has similar properties has become popular as a direct replacement. Linseed, tung and soya oils are those most commonly used in paints and inks as they contain high levels of polyunsaturated fatty acids, which aid drying. Developments with Calendula oil offer a European replacement for tung oil.

4.2.4 Linoleum

Linoleum is made of natural materials: linseed oil, resins, wood, cork powder, calcium, vegetable pigments and hessian (jute). There are new interests in this material and the European market is expected to increase from 36 millions m^2 in 1995 to 56 million m^2 in 2003. Linoleum has particular benefits in 'high-tech' situations in being anti-static. One kg of linseed oil is required for each $1m^2$ of linoleum.

4.2.5 Solvents

The current market for solvents is 4,000,000 tonnes in the European Union of which 1.9 million tonnes are hydrocarbon solvents. Health, security and environmental considerations will progressively increase this market. The potential substitution market could certainly exceed 500,000 tonnes per annum, although at present only 50,000 tonnes of the hydrocarbon solvent market has been replaced by natural oil derivatives.

Solvents are used in paints, varnishes, dry cleaning of clothes, metal treatments, wood treatments, tanning leather, treating textiles and in pharmaceuticals.

Most traditional petrochemical solvents are very environmentally unfriendly and are listed as volatile organic compounds[1] or ozone depleting chemicals. Due to their volatility, the total amount of petrochemical solvents lost in the EU atmosphere reaches 5 Mio tonnes a year (20% of the total EU VOC emissions). In contrast, oilseed-based solvents are fully biodegradable, non-toxic, odourless and do not contain VOCs or PACs[2]. The EU has approved a directive on VOCs setting the objective of a 57% reduction of industrial emissions of volatile organic compounds by 2007.

Oilseed-based solvents have the same cleaning properties as petrochemical solvents, though they offer additional advantages.

- low viscosity (easily applicable to objects which need cleaning);
- can be used manually through wiping, without specialist equipment.

[1] Volatile Organic Compounds (VOCs) refer for instance to volatile hydrocarbon or chlorinated compounds. VOCs cause ground level ozone, leading to the formation of smog.

[2] Polycyclic Aromatic Carbons.

Enhanced R&D efforts could help overcome minor technical limits relating to oilseed-based solvents.

Cost of oil based solvent is higher than that of petrochemical solvents, but consumption is lower, (oilseed-based solvents are not lost by evaporation), and their use requires a lesser amount of fire protection and lower storage costs.

4.2.6 Printing Inks

It is estimated that the world market for printing use is 100 - 120,000 tonnes of vegetable oils (Source: Trenac/Fediol). It is estimated that EU production of printing inks is approximately 530,000 tonnes per annum and current consumption of vegetable oil-based inks is 12,000 to 15,000 tonnes per annum. The market is thought to have the potential by the year 2000 AD to be approximately 25,000 tonnes per annum.

The benefits of vegetable oil-based printing inks, as opposed to mineral-based inks, are:

- considerably improved abrasion resistance; and less 'rub-off'.
- excellent machine stability – less spoilage (0.5 – 0.7%);
- more intense colours;
- less ink usage (10-15%);
- no dry-back
- no VOCs (volatile organic compounds);
- no need for labelling;
- Vegetable oils are not carcinogenic, many mineral oils used are;
- No unpleasant mineral oil smell – vegetable oils are almost odour-free;
- No PCAs (polycyclic aromatic hydrocarbons) (carcinogenic);
- improved lifting properties;
- improved print characteristics;
- considerably less pollution of the environment;
- no recycling problems with waste paper (according to the latest CEPE study).

Belgium was the first EU member state to move to vegetable oil based inks, followed by the Netherlands, the Scandinavian countries, parts of France and Germany. Elsewhere, mineral oil-based printing inks continue to be used for the most part.

4.2.7 Polymers

Whilst the majority of polymers are derived from petroleum, certain products are based upon, or incorporate vegetable oil-based derivatives and there appears to be considerable scope for an expansion in the use of vegetable oils in polymer production. Vegetable oil derivatives can be used in the manufacture of polymers as:-

- Functional additives (where they can alter physical properties). Vegetable oil derivatives are used in slip, anti-block, anti-static and plasticising agents, as stabilizers and processing aids and as flame retardants in the manufacture of plastics. The principal chemical currently produced and used this way is erucamide, which is derived from HEAR and used as a slip agent in polythene film. Erucic acid can be used as the starting material for both nylon-13 and Nylon -13, 13 but no commercial production known.

- Reactive ingredients (where they form part of the polymer chain). Vegetable oils can be used as reactive agents in the manufacture of polyamides, polyesters and polyurethanes. The potential to produce oils from modified plants and for using biotechnological processes to convert vegetable oils into polymer substrates is substantial.

- Direct production of polymers. Polymers can already be derived from plants via the bacterial fermentation of carbohydrate feedstocks. Further genetic engineering is opening up the possibility of producing oilseeds that synthesise polymers in the plant itself.

4.3 Barriers to Progress

4.3.1 Crop production

It has been postulated (section 4.1) that demand for European vegetable oils for non-food uses will increase by 20,000t/annum (4.3%) up to 20004. There appear to be few scientific limitations to the increased production of existing vegetable oilseeds in Europe (Oilseed rape (Double low and high erucic), Sunflower and Linseed). General increase in productivity has consistently occurred as the result of plant breeding and improved agronomy. It is important that sufficient input continues to improve productivity and reduce inputs through an improved understanding of individual crop physiology. An increased crop area is likely to be the most positive method of providing the anticipated increased demand.

There are some technical limitations to the introduction of new modified oil profile types of rapes which need to be overcome, although high oleic sunflower appears to commercially acceptable. Further development of ‘designer’ oil profiles is likely to be the fastest way to meet industry’s needs. The development of the soya bean crop could enhance vegetable oil production but climatic restrictions are likely to limit the crops potential. The domestication of new species with useful fatty acid profiles to diversify crop species is occurring, but progress is slow and needs both industry demand and biological improvement to focus on a small selection for successful commercialisation.

Oilseed rape is prone to shattering which gives rise to a significant volunteer problem in subsequent crops. Crop development studies to minimise this problem would increase yield and reduce costs and problems in subsequent crops. The development of a number of types of sunflower and oilseed rape could give problems of future crop purity and identification. The development of visual markers for each crop type could have significant long-term benefit.

The oil extraction industry is based on old technology; the development of improved extraction technology needs to offer cost savings, improved environmental practice and the ability to handle an increasing range of crop types.
The overall value of oil crops depends on a market for crop by-products. Traditionally these have been used as animal feed but increasingly by-products are less able to meet the requirements of the animal feed manufacturers. New products, particularly in the non-food area, are required to improve the total income from oilseed crops.

4.3.2 Industrial Use

While considerable substitution of European vegetable oils for imported tropical oils, animal fats and mineral oils is theoretically possible, it is unlikely to occur because European vegetable oils are generally more expensive. Substitution is more likely to occur for environmental and customer preference reasons.

Major technical performance barriers remain to be overcome to enable vegetable oils to be more widely competitive with mineral oils.

Lubricants

- Development of new biodegradable environmentally friendly products.
- Development of new products based on high oleic oils where high oxidative stability is required.

Solvents

- Development of new vegetable oil based solvents to meet EU VOC directive by 2007.

Surfactants

- Replacement of tallow by vegetable oils in personal surfactant products.
- Development of soap formulations using C18 fatty acids to replace tropical C12/14.

4.3.3 Economic

Price is a major barrier to development. European oilseed prices are not competitive in comparison with the world market prices for vegetable and mineral oils.

The impact of Agenda 2000 on the production of non-food oilseed production is likely to be negative. The projected prices for main oilseed crops are reduced, particularly linseed. It is postulated that this will be a barrier to meeting increasing demand. While the reforms suggest a 10% set aside area, the between year area will fluctuate. This unpredictable fluctuation in area causes significant problems to producers growing non-food oilseeds on set-aside and to industry utilising the production. Industry cannot plan investment and development when the raw material supply is so variable.

4.3.4 Environmental

Oilseed crops produced by gene transfer offer a potential to meet industry oil profile demands, but are currently unacceptable to the general public. It will be necessary to devise acceptable environmentally friendly production practices to minimise pollen transfer and public anxiety to enable commercialisation of these types.

Much of the benefits of vegetable oils are built on biodegradability and good ecotoxicity performance. These benefits must be seen to be maintained in all new products.

The environmental benefits of vegetable oils are poorly communicated to the general public. Education coupled with EU-wide schemes to label environmentally friendly products based on vegetable oils [as already exist in some countries] would enhance consumer demand.

4.3.5 Legislative

To enhance the development of vegetable oil based products and to meet International Agreements on Climate Change and Biodiversity an EU legislative framework should be established. This would be particularly aimed at extending the legislation with regard to protection of the environment from pollution by mineral oil based products.

European List of Notifiable Chemical Substances Regulations (ELINCS) and the European Inventory of Existing Commercial Chemical Substances Regulations (EINECS), are a major burden and constraint on industrial development and exploitation of new feed stocks from plants. Consideration should be given to ameliorating its impact for large and small-scale industries, otherwise R&D investment in new products will be seriously impaired.

4.3.6 EU Actions

The position of non-food oilseeds in Agenda 2000, particularly in relation to set aside and acceptable crops needs urgent review to minimise barriers created to increased non-food oilseed production.

The WTO Blair House accord poses limitations on oilseed production. The position of EC/US Oilseeds Agreement post 2003 needs clarification and any barrier to increased non-food oilseed production removed.

It would be helpful to long-term research and investment by industry if the EU could produce a definitive long-term statement governing industrial crops and ensure integration of policy making in EC.

There is continuing need for EC support of research and development, particularly to help overcome scientific/technical barriers. More of this support should be directed towards pilot projects to bridge the gap between scientific small-scale developments and full commercialisation.

4.3.7 Communication

Communications between the main participants in the non-food oil industry, farmers, seed vendors, storage operators, research bodies, crusher, refiners and industrial users need improvement. Only by multi-path communication will confidence and requirements of all parties be defined and understood.

Communication of the new vegetable oil products and their environmental benefits, to industrial and domestic users will overcome the lack of knowledge and enhance product demand.