

UNDER REVISION

# FEDIOL

CODE OF PRACTICE  
FOR THE MANUFACTURING OF FEED MATERIALS  
FROM OILSEED CRUSHING AND REFINING PLANTS

March 2002

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## **1. Introduction**

In the oilseed crushing industry different types of oilseeds (e.g. soyabean, rape seed, sunflower seed, linseed etc.) are processed (crushed) for the production of vegetable oils – mainly for human consumption but also for animal feeding and for technical purposes – and for the production of oilseed meals which are used as protein rich feedingstuffs. Usually crushing plants have integrated refining facilities that produce fatty products which can be used as feedingstuffs as well.

### **1.1. Purpose of this guideline**

This code of practice describes guidelines for the production of safe feed materials by establishing a set of principles for production (purchase, transport, storage, processing) and feed safety control (conditions for production process, inspection, analysis etc.). This “code of practice for the manufacturing of feed materials” is a supplement to the existing FEDIOL codes (List of FEDIOL codes and recommendations in annex II).

### **1.2. Feed safety control and quality management**

The crushing industry forms an important part of the production chain for feed and food products. It is the responsibility of each operator in the chain to implement good practices to ensure the safety and quality of his products.

High standards on safety can only be achieved through quality management, for which internationally recognised systems are available (e.g. GMP, HACCP, ISO etc.). In order to ensure the safety and quality of feed materials, all processing steps must be described, the possible hazards must be analysed and the critical control points must be identified throughout the supply and processing chain. Chemical, physical and biological hazards which may affect human or animal health must be analysed and identified by applying the HACCP principles. Necessary corrective measures must be established. They should be taken whenever an inadmissible deviation is recorded at a critical point.

This code is a guideline for individual companies to establish a HACCP handbook. This code establishes the principles of feed safety by identifying the potential hazards which may affect human or animal health.

It defines the means of their control and identifies the critical control points which must be monitored in order to avoid or minimise the occurrence of hazards which may endanger the product safety. Product safety is an intrinsic aspect of quality.

In order to further clarify the production process, the different process steps are shown and explained in four flow charts in annex I.

## **2. Facilities and equipment**

The layout, design and operation of the facilities and equipment must provide the optimal conditions for the manufacture of safe and high quality feedingstuff materials. This means separate and dry storing of raw materials and hygienic processing conditions. For example, the product flow must be designed in such a way, that condensation and the growth of micro organisms is prevented. Regular control and adequate actions must be taken against undesirable animals, like rodents, insects, birds. To guarantee the required hygienic standard it is necessary that the facilities are cleaned regularly.

## **3. Personnel**

The staff must be adequately educated and continuously trained for their job, in particular with regard to aspects relating to safety and hygiene. The staff should wear garments appropriate to the process being carried out which ensure safe and hygienic working conditions. The staff must have health checks on a regular basis.

Duties and responsibilities must be clearly identified at each stage of the production process by means of an organisation chart. Employees must be kept abreast of developments and evolution in their area of responsibility through periodical training and internal instruction sessions.

## **4. Purchase of raw materials, transport and storage**

### **4.1. Purchase of raw material**

Oil mills purchase their raw materials from local suppliers as well as from suppliers all over the world on the basis of contracted quality conditions. Oil mills must verify that the raw materials used comply with EU and national legislation on undesirable substances.

Sampling and analyses plans must be established to cover all incoming raw materials. Samples must be retained for at least 3 months.

### **4.2. Transport**

With a view to preventing contamination with undesirable substances during transport, specific requirements with regard to transport by lorry, train and ship are established:

- Loading compartments must be properly cleaned and must be free from material from the previous cargo.
- Contamination with undesirable substances must be excluded during transport.
- Before the loading of a ship, the inspection of the loading compartment is obligatory.

#### **4.3. Storage**

Storing facilities have to be protected against external influences e.g. weather, birds, rodents, insects etc. The individual storage units have to be marked clearly and the taking in and out of storage has to be documented in order to allow for traceability of the products.

### **5. Oilseed Processing**

The oilseed processing is shown in the enclosed flow charts (annex I). Below, the individual processing steps are described, pointing out the control points which are essential in monitoring the safety and quality of the products.

#### **5.1. Cleaning of the seeds**

As a first step the seed is cleaned and dried. Foreign material (like stones, glass and metal) is taken out by sieving and magnets and disposed of outside the feed chain.

Drying is performed by avoiding contact with combustion gasses unless natural gas is used, if validated.

#### **5.2. Preparation**

The preparation of the seeds before an extraction step depends on the kind of seed and the required quality of the meal.

Seeds with a high oil content, like rape seed and sunflower seed, are usually mechanically pressed in expellers after a preheating step in indirectly heated conditioners. The expeller cake will then further be treated in the extractor.

In some cases the expeller cake is not further extracted but after deep expelling sold as such for feed purposes.

Soyabeans, with a relatively low oil content, are mechanically and thermally treated, and further extracted.

Some oilseeds, like soyabeans and sunflower seed, may be dehulled after the cleaning step. After dehulling the meal will have a lower crude fibre content, and hence a higher protein content. The hulls can also be used for feeding purposes, as such or in pelletized form.

### **5.3. Extraction**

The pre-processed seed (soya flakes) the expeller cake, is then extracted in the extractor in a multistage counter-current procedure with the help of a solvent (hexane) until the remaining oil content is reduced to the lowest possible level.

### **5.4. Desolventising and Toasting**

The hexane-containing meal is treated in the desolventising toaster with the help of indirect heating and steam.

The desolventising toasting process serves three purposes. Firstly, to win back the solvent from the meal, secondly to increase the nutritional value of the meal e.g. by reducing the content of glucosinolates or trypsin inhibitors, and thirdly to minimise the risk of biological contamination.

### **5.5. Drying, cooling, storage**

To obtain a stable and transportable feed material that is fit for storage, the meal is subsequently dried and cooled. During this process, the water content of the meal is reduced from 18 – 20% to below 14%. In general, oil meals are stored in silos. At present, the packing in bags is limited to exceptional cases. In order to avoid the sticking of the oil meals to the wall of the silo, it is common practice that an anti caking agent (amongst others mineral clays like bleaching clay) is added. This is particularly necessary when the silos reach considerable heights. The anti caking agents used are those permitted by feedingstuff legislation.

### **5.6. Production of crude oil**

#### **5.6.1. Desolventising**

The miscella – a mixture of oil and solvent – is separated by distillation into two components, oil and solvent (usually hexane). The solvent is recycled into the extraction process.

#### **5.6.2. Degumming**

During the degumming process the phospholipides in the oil are hydrated with water and then separated from the oil by centrifuges. These gums can either be dried by further production steps and sold as native lecithin for food- and feed purposes or can be brought back into the toaster, since the oil components as well as the phospholipides are high quality feed ingredients. After the degumming process, the crude oil is dried.

## **6. Special protein products**

### **6.1. Soya Protein Concentrate**

In order to improve nutritional value and remove or inactivate anti-nutritional factors, soya meal from an extraction plant can be processed further into Soya Protein Concentrates (SPC). Soya bean meal and SPC can be further processed to raise the protein level above 85% (moisture free basis).

#### **6.1.1. Extraction**

SPC is produced by removing the soluble carbohydrates from the soya meal (flour) by a water ethanol mixture. The protein concentration is raised from around 50% to a level above 69% (moisture free basis).

#### **6.1.2. Desolventising and toasting**

For the purpose of recovering the solvent, the product containing water and ethanol is treated in the toaster with the help of indirect heating and steam.

#### **6.1.3. Drying and cooling**

In order to obtain a stable and transportable feed material that is fit for storage, the SPC is subsequently dried and cooled. During this process, the water content of the SPC is reduced to a level below 9%.

### **6.2. Full fat soya bean meal**

Energy dense feedingstuffs can also be obtained from soya beans without extracting the oil, which are commonly referred to as Full-fat Soya products. The seeds are processed to different degrees, mostly by heat treatment, in order to reduce the anti-nutritional factors (trypsin inhibitor activity) naturally present in the soya bean. The processing may also involve some degree of size reduction, varying from cracking to grinding, flaking, extrusion, etc.

#### **6.2.1. Preparation**

Soya beans can be cleaned and heat processed without prior preparation, but this is only done when meant for ruminant feed. Most often, the cleaning and preparation is similar to that of seed going to crushing (5.1 and 5.2), with the possibilities of being cleaned, cracked, flaked and dehulled.

#### **6.2.2. Heat treatment**

- a) For toasted full-fat soya, a single heat treatment is applied in a toaster similar to that used for the extracted meal.

- b) For extruded full-fat soya, the cracked or flaked beans are heat conditioned prior to extrusion at high temperature and pressure.

### **6.2.3. Drying, cooling, storage**

The heated product is dried and cooled to moisture content below 12 % prior to storage.

## **7. Products from oil refining**

The crude vegetable oil, obtained by pressing and/or extraction is sometimes used directly for feed purposes. In most cases, however, the crude oil is refined in a multistage process.

By-products of the refining process can be used as a single feed material, or can be fed back into the meal (the latter is particularly the case in integrated crushing/refining plants). Below the main stages of the refining process are briefly described, indicating the different products, derived from this refining process, that can be used as feed material.

### **7.1. Removal of fatty acids**

Alkali neutralisation removes the following components: free fatty acids, residual phosphatides, oxidation products of free fatty acids, residual proteins, carbohydrates, traces of metals and a part of the pigments.

The treatment consists of a reaction with an alkali-solution. As a result of this treatment a second phase is formed (soap stock), in which the above mentioned substances are dissolved. This phase is separated and used as a feed material or it is put back into the meal. The soap stock can also be further processed (acid treatment) into fatty acids. Fatty acids are also used for feed purposes.

### **7.2. Bleaching**

During the bleaching process of vegetable oil, activated clay minerals (bleaching earth, silicates) are used to separate primarily natural pigments. Also residues of phospholipides, trace elements, proteins and soap are removed from the oil. In integrated crushing/refining plants the used bleaching earth is brought back into the meal. Bleaching earth originating from pure refining plants and/or hardening plants, which can contain nickel, is excluded from recycling into the feed materials and is disposed of outside the feed sector.

If vegetable oils contain unacceptable levels of PAH's (polycyclic aromatic hydrocarbons), activated carbon is added to absorb and eliminate the PAH's. The used activated carbon is separated by filtration and disposed of in a suitable way outside of the food and feed sector.

For maximum levels of PAHs, this code refers to the standards defined in the FEDIOL Code on PAHs.

**7.3. Winterization**

During the winterization process the waxes are crystallised and removed in a filtering process by means of a filter aid, normally kieselguhr (also called diatomite or diatomaceous earth) or perlites.

Kieselguhr is a biogenic sedimentation mineral from which the organic components are removed by thermal treatment. Hence it is ground by careful milling.

Perlites are selected clays of volcanic origin which undergo thermal treatment and hence are ground.

The filter cake that remains after the filtering process consists of oil, waxes and filter aid. The filter cake can be recycled to the toaster and added to the meal (integrated crushing/refining plant) or sold as such as a feed ingredient (refining stand alone).

**7.4. Deodorisation**

The deodorisation or steaming process removes undesirable odour- and taste-substances by means of steam treatment.

The deodorizer process can have two different by products, depending on the pre-treatment of the oil; fatty acid distillates and distillates.

Both by-products derived from this process contain in particular fatty acids, aldehydes and ketones. Due to the relatively high content of fatty acids and tocopheroles, fatty acid distillates and distillates can be used for feed purposes provided that these by-products and the raw materials used for their production comply with EU and national legislation on MRLs for pesticides and other contaminants (see FEDIOL recommendation on pesticides residues and dioxin in fatty products for feed purposes).

**8. Quality control, storage and transport of oils, oil meals and fatty by-products****8.1. Quality control**

It is the objective of quality assurance to prevent contamination (e.g. mixing with residues of previous cargoes) and to minimise the deterioration of quality of the products during storage and transport to the processor or to the end user, due to improper handling or storage.

Product-control of the finished oil meal is of particular importance. After cooling, the finished meal is analysed to assure that it complies with feed legislation requirements and the quality specifications of the customers.

The composition of oil meal is analysed continuously on protein-, water- and fat content. Oil meals, oils and fatty products are subject to monitoring programmes on quality criteria and the presence of undesirable substances.

Below, the main control points of the above monitoring programmes are listed:

|                                | <b>Oil meal, hulls and Special protein products</b>  | <b>Oils and fatty by-products</b>  |
|--------------------------------|--|--|
| <b>Ingredients:</b>            | <ul style="list-style-type: none"> <li>• Protein, water, fibre, fat</li> </ul>   | <ul style="list-style-type: none"> <li>• Fat, water</li> </ul>   |
| <b>Quality criteria:</b>       | <ul style="list-style-type: none"> <li>• Urease activity (soya bean meal)</li> <li>• Content of glucosinolates (rape meal)</li> <li>• Content of hexane</li> </ul> |  |
| <b>Undesirable substances:</b> | <ul style="list-style-type: none"> <li>• Heavy metals (if applicable)</li> <li>• Mycotoxins</li> <li>• Micro organisms</li> </ul>                                  | <ul style="list-style-type: none"> <li>• Heavy metals (if applicable)</li> <li>• Pesticides</li> <li>• Dioxin</li> <li>• PAH</li> <li>• Alkenes of mineral origin</li> </ul> |

### 8.2. Recall

Individual producers must have in place a system for the recall of products to deal with the case that a safety problem is discovered after the product has been put into circulation.

### 8.3. Loading

The transport of oil meals, hulls, special protein products, oils and fatty by-products can take place by truck, by train as well as by ship. In the case that these products are sold ex oil mill, the buyer is responsible for the proper conditions of the means of transport.

The loading operation must take place in dust free circumstances as much as possible. The loading equipment and procedures must be designed in such a way, that they prevent the co-mingling of different

products. Moreover, they must include documentation requirements that assure traceability of the products. It is the responsibility of the oil mills to ensure that the means of transportation are clean and in good condition.

**8.4. Quality requirements for processing aids**

Oil seed crushing and refining is primarily used for the production of high quality food and feed materials. Therefore, the quality requirements do not only apply to the raw materials, the personnel and the equipment and facilities but also to the used processing aids. The requirements for the relevant processing aids are listed below:

| <b>Purpose</b>  | <b>Product</b>  | <b>Quality requirement</b>   |
|---|---|--|
| Extraction  | Hexane  | Oil mills specification, Council Directive 88/344/ EEC <sup>1</sup> on extraction solvents used in the production of foodstuffs and food ingredients                     |
| Anti caking   | Anti caking agent   | Feed quality<br>Council Directive 70/524/EEC on additives in feedingstuffs   |
| Bleaching   | Bentonite/montmorillonite   | FEDIOL bleaching clay specifications <sup>2</sup><br>Council Directive 70/524/EEC on additives in feedingstuffs  |
| Filtering   | Filter aids   | Council Directive 70/524/EEC on additives in feedingstuffs   |
| Neutralization  | Sodium hydroxide<br>Phosphoric acid<br>Citric acid (additive)<br><br>Sulphuric acid<br>Potassium hydroxide<br>Enzymes (for degumming) | Foods Chemical Codex<br>Foods Chemical Codex<br>Foods Chemical Codex, (E-number E330, FDA 21 CFR 182.6033)<br>Foods Chemical Codex<br>Foods Chemical Codex<br>Food grade |
| Desolventising<br>Stripping<br>Toasting<br>Pre-processing | Steam   | Clean water Directive or equivalent<br>Use of food grade boiler chemicals  |

<sup>1</sup> Amended by Directives 92/115 EEC, 94/52 EEC and 97/60 EEC.

<sup>2</sup> Under development

**9. Record keeping and traceability**

Feed materials

In general, feed materials that are produced in oil mills are firstly stored in silos before loading. In order to ensure the identification of each specific lot, samples are kept (at least 1 sample for each ship, train or truck). The feed materials are to be controlled at random for undesirable substances. All analysis results have to be documented completely and all samples have to be kept for at least 3 months.

Raw material

Oil milling is a continuous process. In order to ensure traceability it is necessary to take samples from each lot of raw materials. Each sample is analysed on its composition (ingredients) and periodically samples are analysed on undesirable substances (monitoring). The analyses have to be documented completely and the samples have to be kept for at least 3 months.

**10. HACCP**

Oil meals, hulls, special protein products, oils and fatty products can only be used for feed purposes if they are subject to a product and process specific hazard analysis.

Any modification in the processing steps should automatically lead to a revision of the hazard analysis. After defining the hazards for the different processing steps and products, the control points and the critical control points should be identified, quantified and documented. Finally, the corrective measures should be laid down which describe the actions to be taken whenever an inadmissible deviation is recorded at a critical control point.

| Process step         | Hazard   | Risk       | Type of measures  |
|----------------------|--|------------|---|
| <b>Raw material</b>  |  |            |   |
| Oilseeds             | Undesirable substances<br>(e.g. PAH, pesticides) | CCP/<br>CP | Monitoring system/<br>Depending on origin and<br>raw material |
| <b>Process agent</b> |  |            |   |
| Bleaching earth      | Undesirable substances<br>(e.g. dioxine)         | CP         | Certification of suppliers                                    |
| Filter aid           | Undesirable substances                           | CP         | Certification of suppliers                                    |
| Anti caking agent    | Undesirable substances<br>(e.g. dioxine)         | CP         | Certification of suppliers                                    |

| <b>Process step</b>          | <b>Hazard</b>   | <b>Risk</b> | <b>Type of measures</b>   |
|------------------------------|---|-------------|---|
| Steam injection              | Undesirable substances  | CP          | Analysis food grade   |
| Drying air                   | Undesirable micro organisms (e.g. salmonella)                           | CP          | Hygienic engineering design   |
| Lubricants                   | Mineral oil   | CP/<br>CCP  | Use of H 1 lubricants/<br>Whenever contact with food or feed is possible                      |
| Hexane                       | Aromatic components (e.g. benzene)                                      | CP          | Specified products  |
| Caustics                     | Heavy metals  |             | Food grade  |
| Acids                        | Heavy metals  |             | Food grade  |
| <b>Final products</b>        |   |             |   |
| Hulls                        | Undesirable substances (e.g. pesticides, salmonella)                    | CP          | Monitoring  |
| Special protein products     | Undesirable substances (e.g. salmonella)                                | CCP         | Monitoring  |
| Oil meals                    | Undesirable substances (e.g. salmonella)                                | CP          | Monitoring, use of acid, modification of the plant  |
| Oil                          | Undesirable substances (e.g. pesticides, PAH)                           | CP          | Monitoring  |
| Lecithin                     | Undesirable substances (e.g. pesticides, heavy metals, micro organisms) | CP          | Monitoring  |
| Fatty by-products            | Undesirable substances (e.g. pesticides, PAH)                           | CCP         | Analysis of products<br>See FEDIOL recommendation on pesticides and dioxin in fatty products. |
| <b>Processing</b>            |   |             |   |
| Cleaning                     | Undesirable substances (glass, stones, metal)                           | CP          | Sieving   |
| Treatment with active carbon | Heavy PAH   | CP          | Proper dose of carbon   |
| Pressing                     | -   | -           | -   |
| Extraction<br>Mineral oil    | Entrainment to oil phase  | CP          | Food grade, less than 10 ppm  |
| Toasting                     | Hexane  | CP          | Monitoring in oil meals   |

| <b>Process step</b> | <b>Hazard</b>  | <b>Risk</b> | <b>Type of measures</b>   |
|---------------------|--|-------------|---|
| Drying/cooling      | Recontamination with micro organisms<br>(salmonella, high water content) | CP          | Monitoring/analysis   |
| Deodorisation       | Light PAH,<br>Pesticides contamination                                   | CCP         | Proper process conditions   |
| Storing/loading     | Recontamination with micro organisms                                     | CP          | Cleaning – trash and sweepings not to be added to meal but to be disposed of outside feed chain |
| Personnel           | Hygiene, health, disease   | CP          | Appropriate garments, regular health check, disinfection, cleaning                              |
| Loading filter      | Foreign bodies   | CP          | Install and monitor filter  |
| <b>Facilities</b>   |  |             |   |
| Cleaning            | Undesirable substances<br>(e.g. salmonella)                              | CP          | Regular cleaning, disinfection  |
| Pest control        | Undesirable substances   | CP          | Control plan  |

CP= Control Point

CCP = Critical Control Point

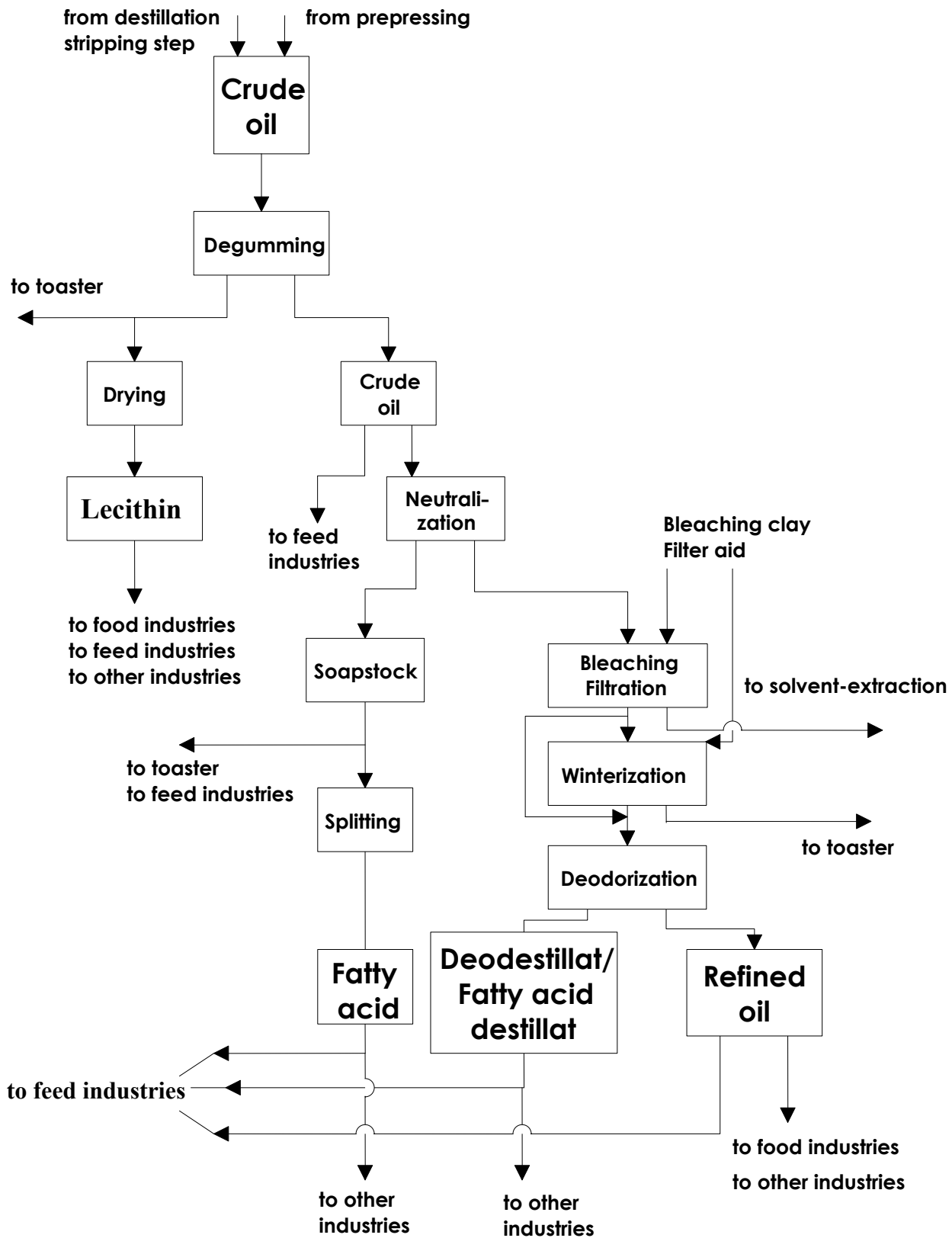
**Annex I**

**Flow charts feed materials production**

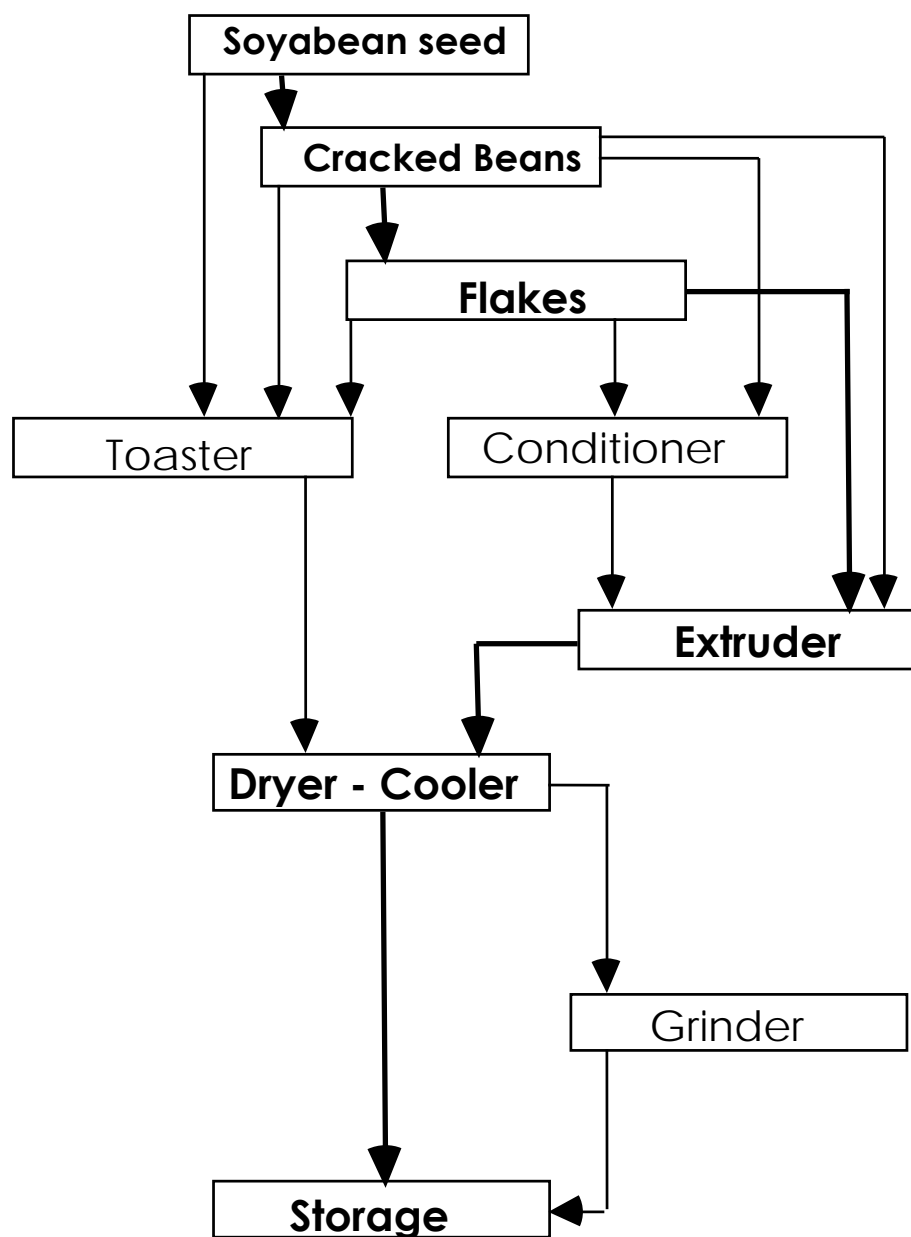
- flow chart crushing
- flow chart refining
- flow chart full fat meal
- flow chart concentrates



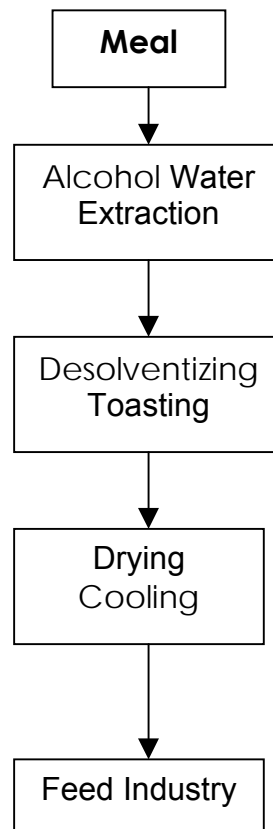
**FLOW CHART REFINING**



**FLOW CHART FULL FAT MEAL**



**FLOW CHART SOYA PROTEIN CONCENTRATES**



**Annex II****FEDIOL codes and recommendations**

- FEDIOL Code of Practice on Polycyclic Aromatic Hydrocarbons (PAH)
- FEDIOL Code of Practice on the heating of edible oils during processing
- FEDIOL Code of Practice for the transport in bulk of oils and fats into or within the European Union
- FEDIOL Code of Practice on pesticide residues
- FEDIOL Code of Practice on the production and labelling of peanut (groundnut) oil in connection with peanut allergy
- FEDIOL Code of Practice for the control of salmonellae in oilseed crushing plants
- FEDIOL Statement on dioxin level in fresh bleaching earth
- FEDIOL Recommendation on pesticides residues and dioxin in fatty products for feed purposes

**Annex III** (updated November 2003)

**EU legislation applying to the manufacturing of feed materials from oilseed crushing and refining**

- Council Directive 70/524/EEC on additives in feedingstuffs
- Council Directive 2002/32/EC on the undesirable substances and products in animal nutrition
- Council Directive 96/25/EEC on the circulation of feed materials
- Council Directive 88/344/EEC on extraction solvents used in the production of foodstuffs and food ingredients