

# PLANT DESIGN

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## THE PLANT FOR PRODUCTION OF VEGETABLE OILS – GENERAL REQUIREMENTS AND STANDARDS OF FARMET SOLUTION



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## Enclosures:

1. Technological scheme of individual operational sets
2. Dispositional scheme of the plant - example



**Fig. 1** – Specialized research and development centre Farmet a.s. in Ceska Skalice

## **1. Introduction**

Farmet a.s. Corporation is an important producer of presses, technologies for further processing of oil seeds, vegetable oils and equipment for feed extrusion. The company has a twenty-year tradition and references in a number of countries worldwide. The stability, proficiency and the high potential of the company were awarded by the title “The Company of the Year 2009” in the Czech Republic. The company has a certified system of a quality control according to ISO 9001. We are continually researching particular processes of pressing the seeds, processing of oils and the quality of feed preparation. We do this with the support of our own development department, modern computing software, and the laboratory fitted with the latest laboratory equipment. Our own intensive development has been supported by the cooperation with several universities and research institutes. We apply the gained knowledge at the equipment construction in the form of KNOW-HOW, which is shown in the high quality, low operation costs and in effective solution of particular processes and projects.

Farmet Corporation also provides consultancy and deals with projects for realization of entire plants for extrusion of vegetable oils using pressing in continual screw presses Farmet.

This material is intended for clarification of basic requirements and attitudes leading to the realization of the entire plant for extrusion of vegetable oils. It deals with the solution of the technological part of the plant and with requirements for the solution of the construction part. It does not deal with designing or realization of the construction part, energy sources or media. Standards of Farmet Corporation for the technological device delivery have been stated there.



**Fig. 2** – Pressing shop for vegetable oils

We recommend studying material “**Production of Vegetable Oils using Farnet Technologies**”, further only “**Production of Vegetable Oils**”, which describes individual pressing technologies, their advantages and disadvantages.

## **2. Description of the process and the technology**

### **2.1. General description of pressing**

General description of pressing is stated in the material “**Production of Vegetable Oils**”. This material deals only with the technology for extrusion of vegetable oils using continual screw presses. In case of using the technology of chemical extraction, requirements on project and construction of the plant are significantly stricter and this material does not deal with them.

We basically understand the pressing process as the only separation of oil from oilseeds.



**Fig. 3** - Oilseeds, oil, pressing cakes

**Oilseeds** are there at the input. **Pressing cakes and oil** are there at the output. Still, we have to take into account the release of aromatic substances, water vapour and dust – See the scheme in Enclosure no.1.

If **hulls** are removed before pressing (typical for sunflower) it

is necessary to count with their storing and their other use.

In the majority of cases the safety cleaning of oilseeds is included at their input to processing. Even though the seeds are purchased already cleaned and dried, it is suitable to include cleaning so that the residual impurities and foreign materials are retained. They could get into seeds by storing and transport (mainly by storing in concrete silos or freely on the floor). Retaining of the dust and sand increases the yield but also protects the inner parts of presses against massive abrasion. In the project it is advisable to count with manipulation and storing of impurities as well. See the scheme in Enclosure no.1.

For clarity the complete technological process is described in detail and divided into a few **operational sets “PS”**, which are closely described below and showed at the technological scheme - See the Enclosure no.1. The operational set PS is a set of machines and devices individually ensuring carrying out given technological operations.



**Fig. 4** PS1 – Input and storing of seeds

## 2.2. Description of individual operational sets of the offered technology

### 2.2.1. PS1 Input, storing and transport of seeds into the pressing plant

In “PS1”, the oilseed is received from means of transport (e.g. Lorries, railway cars) and it is stored in the storage, usually in the grain silos. The oilseed can be stored there for even a few months, thus it is necessary to provide appropriate conditions for storing. The oilseed is transported from the storage by conveyors into the intermediate storage bin situated in „PS2– Pressing plant”.

**Warning! Sufficient supply of the oilseed must be provided for the continual operation of the pressing plant.**

When designing the size and lay out of the storages, it is necessary to result from the local conditions and choose an optimal capacity of stored supplies of oilseed in accordance with the way of purchase and transportation of the oilseed into the place of pressing. With regard to the logistics, the distance between the oilseed storage and the pressing plant is necessary to be as close as possible.

When designing the plant it is necessary to take into account the required means of transport (automotive or railway service) including their routes for departure and arrival. Moreover, a part of PS1 is also material entry pit, storing (silos) and coherent transport routes for filling up silos and for releasing from silos to the input border of PS2.

### 2.2.2. PS2 Pressing Plant

Operational set PS2 is the heart of the plant for extrusion of vegetable oils. Mechanical and thermic treatments of oilseeds prior to pressing together with lining up the presses are chosen according to the used pressing technology. Individual technologies are described in the material “Production of Vegetable Oils”. After reading through you will be able to choose suitable type of Farnet pressing technology fulfilling your requirements.

The scheme in the Enclosure no.1 does not provide particular technological equipment of the pressing plant. This will be drawn after choosing suitable pressing technology. We are pleased to send you detailed information for the chosen type of the technology together with the detailed technological scheme PS2 – Pressing Plant.



Fig. 5 PS2 – Pressing shop

Some oilseeds require removing parts of hulls (dehulling) prior to pressing. This is mostly by reason of lowering the content of fibre in pressing cakes, which then become superior feed.

Dehulling is usually used for sunflower seeds, possibly for soybeans. The extension and size of PS2 is significantly influenced by the demand for hulling and dehulling, therefore this demand needs to be decided at the beginning of the plant project. In that case it is necessary to solve further transport, storing, processing or liquidation of hulls –it means very important volume of material especially in large pressing plants. Hulls can be used as a cheap and readily available fuel for steam generation, which could be further used in hot pressing technology. Alternatively, it is possible to consider a hull-burning power plant.

### 2.2.3. PS3 Oil Filtration

Pressed oil is firstly separated from rough impurities and gathered in a homogenizing tank, where the oil is mixed for the reason of preventing its sedimentation. After filling up the homogenizing tank the oil is filtered on an automatic desk filter. The whole filtering process and regeneration is operated automatically. The operation of the filter (its automatic regeneration) requires sources of pressed air (or steam). Filtered oil is pumped into PS5 Oil Storage. Retained impurities (sediment and filter cake) are returned back into the technology of pressing (PS2) and contented oil is pressed again.

We will be pleased to make you the offer for PS3 – Filtration of Oil.

In any case, we recommend ordering filtration simultaneously to the technology of the pressing plant so that we could prepare and solve all operational consecutives, unification of the equipment and visualization in detail.

For smaller capacities it is also possible to use simpler and less capital intensive type of filtration using desk filters with manual regeneration. The oil is pressed through filtration cloths. Retained impurities are removed manually by dismounting the filter and scraping off the cloths.

We are pleased to send you offer for this solution as well. We recommend using this type of filtration in small devices when processing less than about 5tons of oil per day.

When choosing suitable capacity of filtration it is necessary to result from the volume of oil production (depending on the type of oilseeds and its oiliness). In most cases the capacity of filtration is being purchased with extra back-up performance for possible enlarging the pressing capacities.



**Fig. 6** PS3 - Desk filtration



**Fig. 7** PS3 – Automatic filtration

#### 2.2.4. PS4 Transport and storing of pressing cakes

Pressing cakes from the collective conveyer below presses (collective conveyer is included in “PS2”; stainless steel design is standard) and after eventual cooling (“Option” in PS2), are carried by consecutive transport ways “PS4” to customer’s required places (Pressing cake storage, extrusion or granulation line, extractor, etc.)

This operational set needs to be solved after having particular knowledge about disposition of the building and investor’s requirements. The size of the storage depends mainly on the investor’s wish; what is his required storing amount to make sufficient supply for his business activities or further technologies.



Fig. 8 PS4 – Cakes storage

Based on company’s long-lasting experience we believe that the optimal way of storing the pressing cakes is laying them free on the floor of the storage and providing expedition with the help of the front-end loader. This way is not automatic (it requires operational staff of the loader), however, it has a wide range of advantages compared to silos and underpass supply bins:

- It is not financially demanding even at large storing amounts.
- It provides manipulability in all cases.

It is not possible to use classical grain silos for storing the pressing cake as they have a tendency to stick, get vaulted and freeze on the walls in winter.

**PS4 is always solved according to customer’s requirements with regard to local conditions.**

#### 2.2.5. PS5 Oil storages

Filtered oil is being stored in oil tanks that are equipped with sensors for visualization of the volume of oil in the tanks. Oil release from “PS5” is done by an efficient pump. “PS5” can also be completed with a precise weight flow meter which measures the total release of oil.

**PS5 is always solved according to the customer’s requirements with regard to the local conditions**

We have a lot of negative experience with customer’s underestimating demands on good quality storing of vegetable oils. It is necessary to solve



Fig. 9 PS4 – Oil storage

possibilities of sludging (crude oils form phospholipids, which sediment on the bottom of tanks); sanitation, effective output, separation of various kinds of oil, etc. It is necessary to choose such volume of tanks to provide operation of the pressing plant during Saturdays, Sundays, Public holidays, possibly with extra back-up in case of unexpected failure of oil take-off. It is advisable to have minimum 2 tanks available so that it would be possible to store oil in one tank and clean the second one.

It is possible to use plastic tanks (IBT containers, etc) for small capacities. For larger capacities there are steel or stainless steel containers. It is possible to order already made tanks of the volume 20m<sup>3</sup> and 50m<sup>3</sup>; larger tanks are build at the site.

### **2.3. Sources of energy**

When thinking about the plant conception it is necessary to count on constructing sufficient electrical **power supply**. According to the used technology, a source of steam can be also required (electrical, gas or solid fuel).

When processing oilseeds with large content of hulls, the hulls (shells, or other undesirable parts of the seed) should be removed prior to expeller pressing. Dehulling and hull separation is most frequently used for sunflower, but it can be used for soybeans as well. A lot of energy-rich material is removed also when processing cottonseed or coconuts.

Hulls and other undesirable part of the seed can be used for generation of technological steam or for production of electrical energy using a steam turbine. Therefore, such alternative power sources should be taken into consideration when projecting the concept of a plant.

### **2.4. Auxiliary device**

For providing an overview about oilseed purchasing and selling of pressing cakes and oils, it is suitable to build a **weigh bridge** for weighing lorries (in case you use this kind of transport). The plant should have an equipped **laboratory** for quality analysis of seeds, pressing cakes and eventually oil (for minimal setting of moisture, content of oil in oilseeds and pressing cakes). Further, it is necessary to count on ensuring conditions for operational staff – construction of central control room and **sanitary facilities** for the staff (changing rooms, WC).

In case of storing the pressing cakes on the floor, it is necessary to take into account a means of transport e.g. a **front loader**.

## **3. Basic plant parameters**

### **3.1. Basic plant parameters**

It is necessary to think thoroughly about basic plant parameters and also about basic requirements on individual operational sets and to look for locally best solution.

A team of our specialists is ready to help you find the most suitable solutions. For effectiveness of our cooperation it is necessary to know your basic ideas and possibilities as stated below:

A) **Which oilseeds** do you want to process, what kind of oil do you want to gain and what will be further use, quality requirements for oil and pressing cakes?

It is possible to gain oil from a wide range of seeds. Their properties and technological requirements can significantly differ. Therefore, the technology must comply with the particular kind of seed. If you require processing various kinds of seeds in your plant, we will suggest

objective possibilities of setting the given technology for particular kinds of seeds.

The most processed seeds in the mild climatic zone are sunflower and rape – both types are possible to process in most of the offered technologies without significant technology modification. All offered technologies are not suitable for soya processing for the reason of strongly different content of oil and the necessity of heat treatment (necessary to remove all anti nutritional substances). It is necessary to take into account that when transferring to different type of seeds, you have to not only modify the type of pre-treatment before pressing, change some press components, but also to solve separation of different types of oil and pressing cakes in storages.

For these reasons we do not recommend frequent changes in the type of oilseeds. Optimal setting is reached only in the long-term non-stop operation.

**B) Which amount** do you want to process annually, per day, per hour?

It must be highlighted that the pressing technology requires long-term fixed operation with only a few shut down. Therefore, we do not recommend frequent technology switch off. We usually calculate the plant operation to 330 days per year; it is  $330 \times 24 = 7920$  hours per year. If you want to process for example 20 000tons of oilseed, you would need technology with the daily output  $20\ 000/330 = 60.6$ tons which means an hour output  $60.6/24 = 2.53$ tons of oilseeds per hour.

**C) Which pressing technology** do you prefer?

Various types of pressing are listed and compared in the material „**Production of Vegetable Oils**“. It is necessary to take into account requirements on pressing duality, possibilities and availability of sources (electrical, gas, steam).

**D) How to filtrate oil?**

It is necessary to filter the oil immediately after pressing – it means removing mechanical impurities (solid particles). Otherwise the solid particles sediments and blocks the storing tanks. PS2 Pressing plant is always realized together with complying filtration. Manually regenerated desk filters can be used for small capacities. Higher capacities definitely require automatic desk filters.

**E) What will be the logistics of raw material** – seeds, hulls, pressing cakes and oil?

Which amount of seeds, hulls, pressing cakes and oil do you want to store directly in the plant? How will you ensure the input transport of raw material and dispatch of products?

**F) Which conditions** are necessary at the considered place of installation?

It is necessary to take into account climatic conditions, construction-technical conditions and habits.

Based on your given information in the form of **Basic plant specifications** according to the Enclosure no.3 we will send you more detailed information and offers.

### **3.2. Premises for the plant**

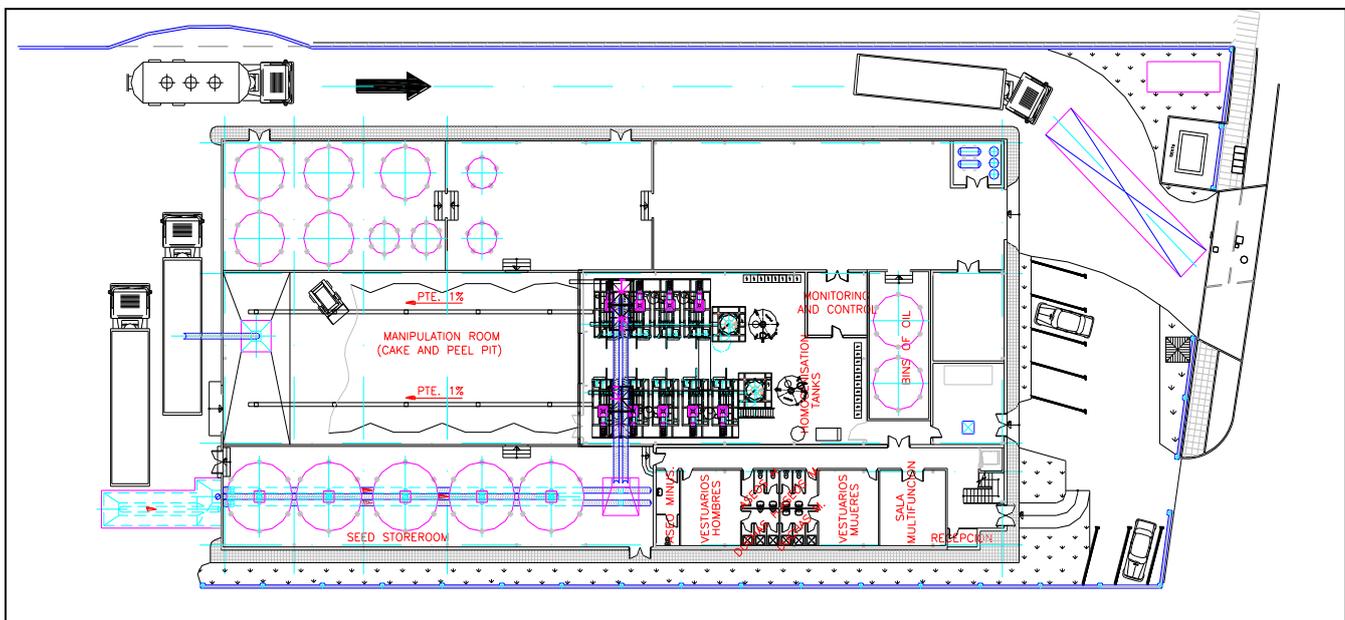
When choosing the locality for placement of the plant a few aspects are necessary to take into account:

- Transport availability (driveway, railway) according to the need of transport of seeds into the plant and pressing cakes and oil out of the plant.

- Energy availability – electrical and in case of hot pressing also gas or directly steam.
- To take into account occurrence of aromatic essences, dustiness and water vapours – see the material “Production of Vegetable Oils“, and their influence on the surrounding buildings according to the local conditions.

For installation of the pressing technology PS2 and PS3 it is necessary to provide insulated building fulfilling requirements of individual types of technologies. Much larger area is usually needed for seed, pressing cakes and oil storing than for installation of the technology. These premises can be solved in different ways.

- Use of separated outdoor silos for seed storing
- Store pressing cakes freely on the floor of a non-heated hall
- Dispatch pressing cakes by the front loader
- Have more individual steel tanks placed in a tempered building for oil storage. Warning – oils are getting solid at lower temperatures and it is not possible to pump them!)
- Have large outdoor tanks with own system of heating for large capacities.



Obr. 10 – Illustrative layout of a pressing plant

### 3.3. Further Requirements

#### Energy

**Electric energy** - technological devise uses voltage system 3+PEN/3 + N + PE, AC 50Hz, 3 x 400 / 230 V. The installed electric input is dependent on the choice of the technology and it will be included in the particular Technical information for the relevant technology and capacity.

**Steam** – is used for heating up the material in the hot-pressing technologies. The need of steam depends on the type of the technology and its capacity. The range of the input steam presses is 0.8 – 1.2. MPa.

**Cooling water** – is used in the hot-pressing technologies for cooling down the press shaft as well as for fast cooling of oil preventing its oxidation.

### **3.4. Operational media**

If the oil in the plant is only filtered and not further processes, it does not require any further operational media.

If you demand further oil processing for food industry - refining, or oil processing for technical use of oil for engine fuel or biodiesel (methyl ester), the specifications of necessary media are included in the particular offer.

## **4. Parameters of the technology**

Determining parameter is the technology output (the amount of processed oilseeds in the time unit) and the amount of the pressed oil. There exist a number of inconsistencies and mistakes in this definition and in understanding these parameters; mostly in their practical determination. That is why this issue is described in detail in the material “**Production of Vegetable Oils**”.

### **4.1. Parameters of the input oilseeds**

To ensure effective pressing it is necessary to pay close attention to the quality of oilseeds. Listed below there are the decisive parameters that affect the pressing process:

**Biological Ripeness and Drying Caution** - these parameters are very difficult to evaluate in practice and there has not been set a single methodology. It is necessary to avoid the following:

- Charred oilseeds (odour, dark colour, hard)
- Atypically light colours indicating unripeness
- Moldy oilseeds and affected in other ways
- Damaged oilseeds – according to most standards, the limit for **damaged seeds is max 2%** (Among other things, the oxidation of oil in the oilseed starts, and this causes deterioration of the quality of oil)

### **Impurities and moisture**

It is estimated that oilseeds come into the plant already dried and cleaned according to standards for trading and storing. There is an upper limit of impurities **max. 2% of impurities**. Even if the seeds are delivered once cleaned; we strongly recommend supplementing the technology with continual seed cleaning treatment of the input seeds entering the technology of pressing PS2. Particularly, if seeds are stored freely on the floor or in concrete silos, they often contain concrete chips and fine sand. As hard materials as are abrasive materials, significantly decrease the service life of the inner parts of presses or extruders. Matter of course is installing magnets for retaining metal pieces.

## Moisture

Moisture is very important parameter for oil pressing. In the simplest technologies (e.g. One-stage cold pressing CP1) you have to rely on the moisture of delivered input seeds, unless a device for drying seeds is installed in the plant. It is necessary to provide delivery of seeds with moisture between about 4-7%. In hot pressing technologies the moisture is regulated before pressing to the optimal level according to the technology and particular oil plant. Thanks to the cooker it is possible to optimize the process and thus reach better results even at changes of the input moisture.

## Temperature

Temperature of the input oilseed should not drop down under 15°C. If there is, thanks to local conditions, a chance of lower temperatures, then it is necessary to install and dimension a system of heating of the input seeds in the plant. In hot-pressing technologies there are steam cookers or conditioners put prior to pressing. When having lower temperatures, mostly in combination with higher moisture of oilseeds, the cooker at full power would not have to be able to heat and evaporate up to the required data. This can be easily solved by lowering the power at extremely low temperature of the input seeds.

We always recommend choosing the “Option” Heating for cold-pressing technologies.

## Oiliness

Oiliness (oil content in the seed) is a key parameter for determining the yield of oil (how much oil will be pressed). In the following Table A are listed values of normally occurring seed species. The technology is optimized for the certain kind.

If oiliness is actually smaller (but in the range of effective pressability according to the table A) the technology will press the oil. The parameter maximum residual fat in the pressing caked will be maintained, but the yield will be lower.

If the oiliness is higher than referred medium, the yield will increase, but the parameter maximum residual fat (see Table B) may be slightly worse (a large amount of oil does not manage to drain away from the press). This deterioration should not be more than 0.2% increase of residual fat in pressing cake per every 1% of higher fat content in the oilseed above the medium level stated in the following Table A.

Table A - Incoming parameters

Oilseeds	Moisture max. for storing	Moisture medium recommended	Oiliness medium at medium moisture	Oiliness Range of effective pressing possibility
Rape	8 %	6.5 %	42 %	38 - 44 %
Sunflower	8 %	6.5 %	43 %	40 - 48 %
Soya	12 %	10 %	19 %	17 - 22 %

Seeds with oiliness out of the range of effective pressing possibility according to this table will also be possible to press, but worsening of parameters and some problems with solid particles and with the stability of the process can be expected

## 4.2. Output parameters after pressing

Output parameters after pressing depend on the used technology and are specified in Technical information for individual technology of pressing in detail. The list of individual technologies is added to the material "Production of Vegetable Oils", where the ways of evaluation of the output parameters after pressing are also described.

## 5. Conclusion

Dear customers,

Prior to starting project and realization work on your investment plan, we recommend contacting us and **ordering a project study** of the particular solution. The price of the study is approx. 3000 EUR + 0,3% from the price of the technology + costs of transport and accomodation for the specialist visiting you in your place (if needed).

"**The Project study**" consists of basic information about requirements for construction, technological equipment and its running, description of the construction, proposed construction-technical solution, demands of the construction and technological device; and data about the influence on health and the environment. The project study further includes drawing documentation of: Space layout, Technological scheme, Floor bearing capacity.

Alternatively it is possible to order complete **Project documentation** for the specific solution of the technology. The price of such an extent is 6000,- EUR +0,6% from the price of the technology + costs of transport and accomodation for the specialist visiting you in your place (if needed). In case of consequential closing of the order on delivery of the technology, the price of the project study will be subtracted from the offered price.

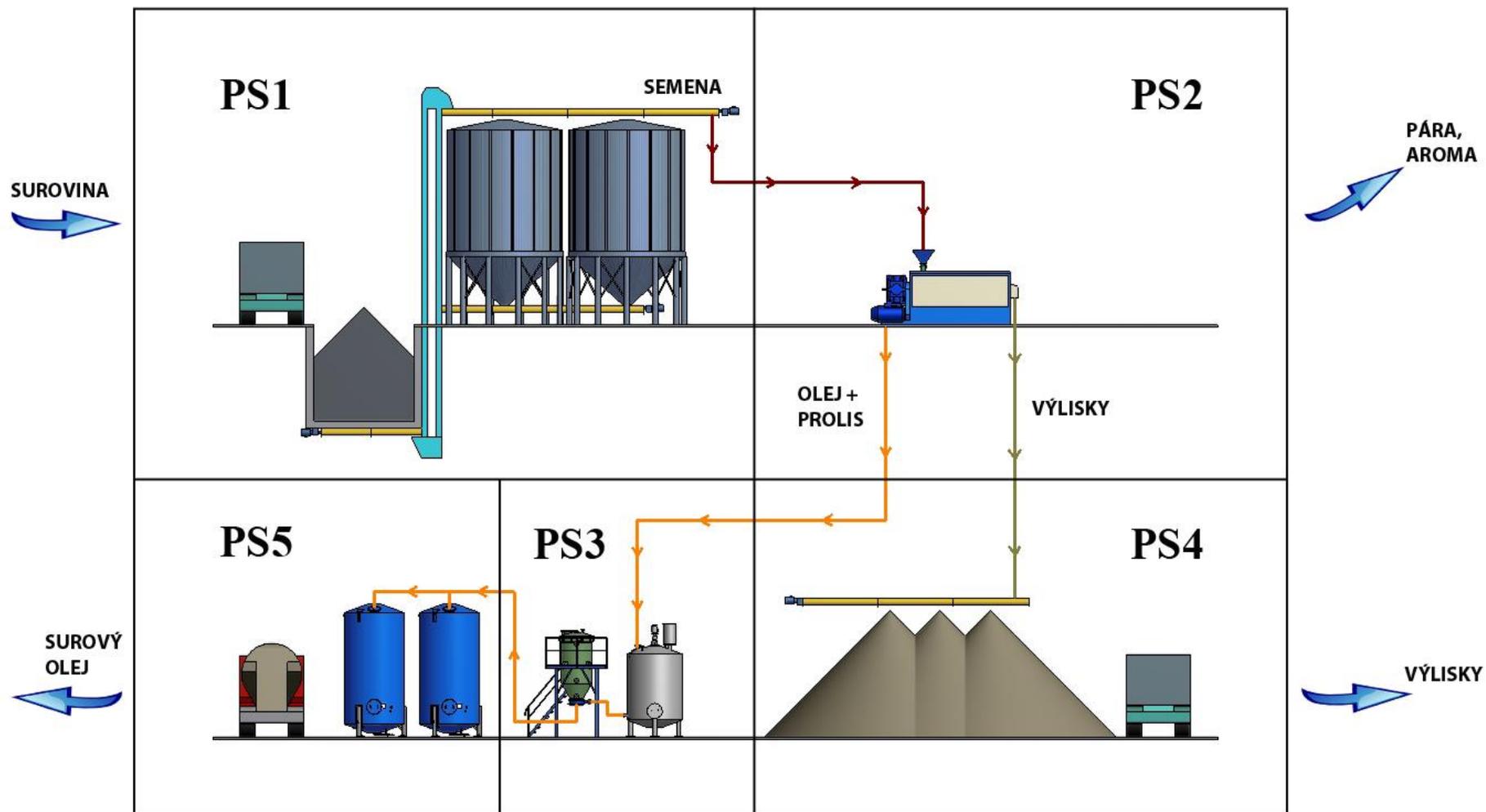
**Project documentation** contains more detailed elaboration of the technology, so that it would be possible to carry out projecting of the building and related technologies up to the level which is necessary for the construction permit. This level of documentation does not contain installation drawings and documentation. The documentation includes the technological part only – the construction project must be done by specialized company with the respective authorization.

Our specialists are ready to offer you a whole range of interesting conceptions and solutions.

Thank you for your interest in our products

Team of specialists, Farnet Corporation

# Encl. No. 1: Technological scheme of a pressing plant for vegetable oils



## Enclosure No. 2: Example of a pressing plant layout

