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The Restructuring Strategy of Petrochemical Industry in Romania

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THE RESTRUCTURING STRATEGY OF PETROCHEMICAL INDUSTRY IN ROMANIA

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1. INTRODUCTION

The history of industrial crude oil period, which began in 1850, is the work of several generations of brave men, many anonymous, who have intuited in black oily fluid the means of existence, a small business and a hope to live much better.

For a small number of people, the crude oil has meant earning fabulous wealth, huge financial resources, political and military power, a permanent struggle for the seizure of new crude oil reserves, but the exile, the wandering, the fear of death, ruin and quite often the bankruptcy. We find in the picture of visible actors within the history of crude oil very different people, with different interests, skills and training, people who often have nothing in common with crude oil, people who have enriched from the crude oil business, but have never seen an oil well or a crude oil refinery [1].

Numerous documents published until now about the “black gold” deals especially the crude oil crises and their consequences on the economy and global finance, the role attributed to crude oil in the World War II, the political and military struggle for supremacy of the rich territories in deposits of crude oil, the dramatic controversy between the crude oil producers and crude oil consumers in forms more or less romantic, with: “prince”, “sharks”, “colonels”, “tycoons” and even “architects” recently, but much less about the rational use of crude oil reserves to raise the living standards of people in the petrochemical industry. [2]

The world crude oil reserves currently available to mankind are limited and, in a foreseeable period of 50 years, these resources may be exhausted, unless new deposits will be discovered and drilling/extraction techniques will evolve to allow the existing exhausted deposits to be economically recovered.

Romania is still listed among the few countries in Europe with proven crude oil reserves at a level of 200 million tons to be exploited, from which 47.8% primary, with high certitude level and which may be exploited/operated by the own oilfield energy depletion and 52.2 % secondary reserves, which can be exploited by supplementing the energy deposits/fields, as shown in Table 1.1. [1]

The potential crude oil reserves that could be exploited in future are about 252 million tons, which means at the current level of crude oil extraction of 4.5 million tons per year, would cover the period from about 56 years or about 25 years at the current consumption level of Romania. A natural question ought to be put, namely: “What is the future of crude oil in general and especially of petrochemical industry, taking into account the specific conditions of Romania who managed the “performance” to self-destruct the petrochemical industry after 1990 and would intend to rebuild this important branch of industry, within the remaining available time?”.

Table 1.1

The global crude oil reserves

Area	**[thousand million tons]**	**[% of total]**
U.S.A.	3.70	2.60
Canada	0.80	0.56
Mexico	4.00	2.81
Total North America	8.50	5.98
South America + the Caribbean	13.60	9.57
Denmark	0.10	0.07
Italy	0.10	0.07
Norway	1.20	0.84
Romania	0.20	0.14
United Kingdom	0.70	0.49
Other countries	0.20	0.14
Total Europe	2.50	1.76
Former U.S.S.R.	9.00	6.33
Middle East	92.50	65.10
Africa	10.00	7.04
Asia – Pacific	6.00	4.22
Total at global level	**142.10**	**100.00**

To answer this question correctly, we should keep in mind the advice of Saint-Exupery: "We do not inherit the earth from our parents, but we rented for our children". If we act in the spirit of this phrase and we did not waist the crude oil, especially on fuels and through the escalation of a so-called high life style, is possible that an answer would be easier to be given.

"The Prophecies" of the danger of depletion of world crude oil resources are known for a long time. Among those people, we have to remind:

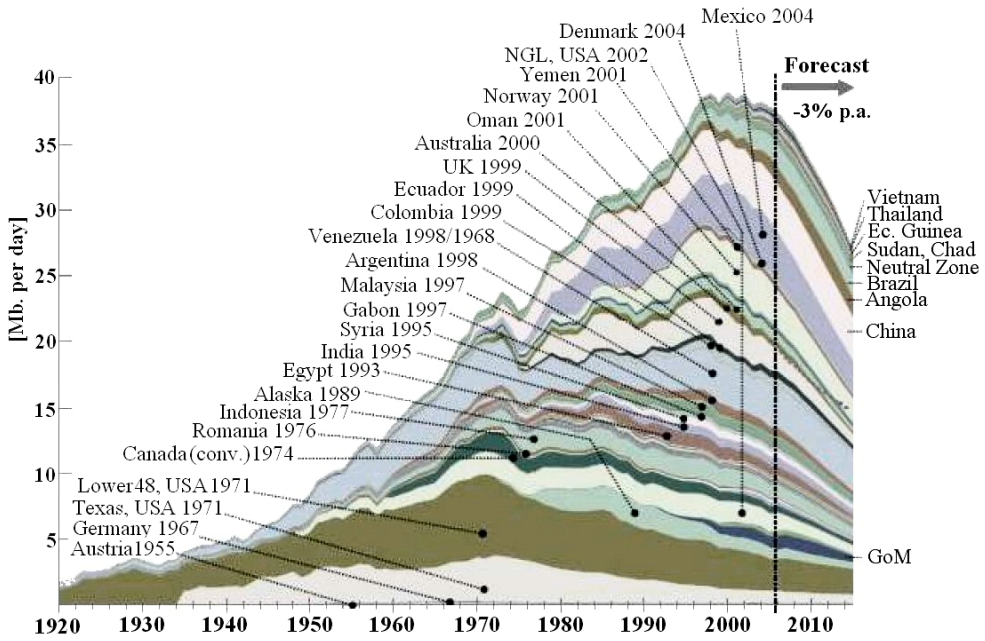
- Svante Arrhenius, Swedish physicist, author of the theory of electrolytic dissociation of ions, Nobel Prize laureate in 1903 – predicted in 1923, the world crude oil depletion in 20 years, that is in 1943;
- Edgar Faure, political and legal advisor of French origin, chairman of the Council of Ministers of France between 1952 and 1955, predicted in 1939 the end of crude oil in 10 years, that is in 1949;
- Jean Chardonnet and Jean Marie Chevalier – provide in 1973, the depletion of crude oil in the year 2000.
- Dr. M. King Hubbert, geophysicist who in 1956 created a mathematical model according to which the total amount of crude oil extracted from an oilfield in time follows a bell shaped curve, reaching a peak, then begin to fall until exhausted. Based on this model predicted the U.S. crude oil extraction will reach a peak in 1970 and will be exhausted before the end of 21 century.

What is certain is that none of the above predictions were not achieved, fortunately, until today, and in this area/field there are not clear assurances regarding the crude oil reserves depletion due to the multitude of factors that seek to define the problem.

In the following step we attempt to present projections of exhaustion/depletion for the most important crude oil producers.

Figure 1.1 is presenting the achievement of a maximum in crude oil and natural gas extraction.

It results that U.S. crude oil production reached the peak of maximum of crude oil production in 1971, Russia in 1988, Europe in 2000, and the Middle East will reach it in 2006 – 2007. Romania has reached the peak for crude oil production in 1976, with 15 million tons.



Ludwig-Bölkow-Systemtechnik GmbH, 2007
Sourse: IHS 2006; PEMEX, petrobras; NPD, DTI, ENS(Dk), NEB, RRC, US-EIA, January 2007
Forecast: LBST estimate, 25 January 2007

Fig. 1.1. The achieving of maximum of crude oil production.

What seems weird is that although we are in a maximum overhead, the people exhibit a contagious unconscious, their behavior is similar with the case when crude oil would be inexhaustible, the alternative resources would be discovered and made ready to work efficiently, and we, the people, we are just wasting little more oil that's left, the fuel, powerful luxury cars, a profligate lifestyle for people with opportunities and deprivation only for people who have not yet adapted to globalization mechanism.

All these predictions are based on the ratio of proven reserves and crude oil production, respectively, to that global crude oil consumption at a time.

We are in year 2010 and the forecasts were true for the U.S., Russia and Romania are likely to come true for the other bigger crude oil producers in the Middle East or for those grouped in OPEC.

A deposit is considered exhausted when the costs of crude oil extraction exceeds the value of crude oil extracted, at which point the deposit goes to conservation. With the current technique for a barrel of crude oil energetic consumption is obtained from the deposit about 10 barrels of crude oil, depending on the oilfield, geographical area,

the pressure in the layer, 3 barrels from bituminous shale, 9 barrels coal equivalent, 10 barrels nuclear energy equivalent, 40 barrels solar energy equivalent, 80 barrels equivalent wind energy equivalent and a deficit of 0.5 barrels equivalent which comes from the usage of hydrogen as an energy source. At the current level of knowledge, the solar energy, the wind energy and the hydroenergy can not cover even the astronomical consumption of the Western countries, because the use of solar technology is still in the "stone age", the wind energy cannot be recovered in all regions, and hydroenergy require major investments.

We believe that more important than the forecasts about the end of crude oil reserves are the proven ways of saving, reduction of waste of crude oil for energetic purposes and more rational use of this precious material for the petrochemical changes.

The elaboration of a sustainable energetic strategy of Romania can not be considered as a target and a responsibility for a group, a political group, government, due to the diversity and specificity of the knowledge included in a strategy and therefore is necessary to be engaged and a wider circle of more prepared specialists from the fields of activity concerned, specialists which Romania already has, but specialists which the post-December governments avoided them with obstinacy.

Focusing more on the discovery of new resources, without thinking how we use the resources we already have and wasting it now, is a bizarre way to think strategically.

Sustainable Development Strategy of Romanian energy sector requires not only providing resources but, above all, how to use the internal resources or imported ones, on more money. This state can occur, even minimally, to create the stimulating frame from the economic incentive, taxes and legal point of view, which will be tempted for investors to a better exploitation of the energy resources.

To develop a strategy for revitalizing the petrochemical sector in Romania is not a matter of fashion or a group, but is a stringent economic necessity, taking into account the exorbitant amounts of money that is going on petrochemical imports after 1990. The globalization and specialization in certain areas should not be confused with the export of the national income from alienation of the national oil resources and suppression of industries such as petrochemical industry, in which Romania is already an expert of 60 years.

The energetic strategy should be preoccupied with saving of existing resources by providing economic incentives, legislative, fiscal facilities for the private investors, Romanian or foreigners who want to rebuild petrochemistry, just as other sectors that are suffering or were even eliminated after 1990, sectors whose products assured market outlets in Romania and especially for export, the balance of import/export.

The withdrawal of the state from the economy may be beneficial, but not by so-called strategic privatizations according to which the national energy resources were transferred for the benefit of the foreign state companies, for example OMV Petrom privatization, where the Austrian state owns the majority shares/stocks package.

The future of petrochemical industry can not be inferred out of the context in which is now Romania as a country member of the European Union and NATO – North Atlantic Treaty Organisation, conditions in which certain attributes of domestic politics and external politics will be delegated to decisions taken at EU level, including of course the strategy of power/energy development.

2. THE CURRENT STATE

In the 1960's, with 10 years later than to the other countries from Western Europe, which imported modern petrochemical technologies from USA, Romania is modernizing the crude oil refineries by American technologies (catalytic reforming and catalytic cracking – Brazi) and started the construction of the first industrial petrochemical units (pyrolysis, polyethylene dimetiltereftalat – Brazi) by importing second hand licenses from Western Europe which originally came from the American companies. You can see here the difference in strategy of the refinery engineers with industrial tradition and young petrochemistry engineers recently converted between the chemists and oilmen [1].

Despite the inherent hardships specific to any start, the petrochemical industry has consistently developed into integrated refinery-petrochemical complex, starting in 1960 until 1989, long before the XIII World Crude Oil Congress held in November 1991 in Argentina, in Buenos Aires, when were presented as something new the technical and economic benefits brought to the integration of crude oil processing with the base of petrochemical production.

In the period we refer, the petrochemical industry in Romania has developed relatively in a balanced way, on the following industrial sites, mentioned in the chronological order of their appearance: CAROM – Onesti, Petrobrazi – Ploiesti, Arpechim – Pitesti, Oltchim – Ramnicu Valcea, Doljchim – Craiova, Petrotel – Ploiesti, Solventul – Timisoara, Petromidia – Navodari.

On these platforms were built 95 large petrochemical big units, from which, after 1990 has remained in running only 8 industrial units in Oltchim: (VCM, PVC, Oxo-alcohols, AF, PO, PE, DOF and chlorinated products) and 4 units in Rompetrol – Petromidia (Pirolysis, HDPE, LDPE, PP), the remaining 83 units were stopped, demolished and sold as scrap by the new owners as follows: 16 units from Arpechim and at 23 units from Petrobrazi, demolished by OMV Petrom after privatization in 2004, 14 units from Doljchim, by OMV Petrom, too, another 7 units from Petrotel by Lukoil, 2 units from Petromidia by Rompetrol, 11 units from CAROM, 4 units from Chimcomplex, 3 units from Solventul and 3 units from Copsa Mica.

The industrial threads and synthetic fibers have been closed and demolished the following units: Fibrex Savinesti, Melana Savinesti, Terrom Iasi, Firmelbo Botosani, Polirom Roman, Moldosin Vaslui, Corapet Corabia, and Grulen Campul Lung [1,2,3].

That means that today Romania no longer produce its petrochemical base produced in the past, but which are imported now, like: polystyrene for general use, expanded polystyrene, ABS, polymethyl methacrylate, SBR rubber, nitrile rubber, polybutadiene rubber, polyisoprene rubber, terpolimers, phenol, acetone, acrylonitrile, acetonitrile, hydrogen cyanide, sodium cyanide, maleic anhydride, ethanolarnine, acetaldehyde, acetic acid, vinyl acetate, acetic anhydride, polyvinyl acetate, polyvinyl alcohol, polycarbonates, latex, bisphenol, carbon black and much more.

Table 2.1

Production, export and import of petrochemical products in Romania between 2003-2008 [thousand tons]

Nr.	Produs	2003			2004			2005			2006			2007			2008		
		Prod.	Exp.	Imp.	Prod.	Exp.	Imp.	Prod.	Exp.	Imp.	Prod.	Exp.	Imp.	Prod.	Exp.	Imp.	Prod.	Exp.	Imp.
1	Ethylene	158.0	-	-	183.0	-	-	173.5	-		180.8	-	12.0	165.0	-		51.3	-	
2	Propylene	199.4	7.7		236.5	8.6	17.2	268.6	4.1	4.7	268.2	40.2	13.2	232.0	14.3		249.5	13.9	
	- refinery	142.4			168.1			200.3			192.0			164.8			177.9	0.9	
	- pyrolysis	57.0			68.4			68.3			76.2			67.2			61.6	13.0	
3	ACN	81.8	82.7	-	83.4	83.2	-	85.1	83.1	-	50.6	53.0	-	-	-	-	-	-	-
4	MEG	17.8	11.9		25.8	21.6	0.9	23.2	13.8	2.4	27.0	24.2	24.4	7.0	7.1		6.3	5.6	
5	Phthalic anhydride				15.8	4.5	1.1	5.6	4.1	0.3	16.3	0.7	1.1	14.2	0.1		20.0	0.2	
6	Maleic anhydride	4.8	4.2		4.8	4.3		5.2	4.6		4.6	4.6		1.4	1.6		1.0	1.2	
7	Polyethylene	69.8	13.4		84.0	25.4		72.2	14.2		81.3	17.9		142.9	61.4		174.8	97.9	
	- HDPE	58.4	12.5		74.6	24.2		62.9	12.6		59.5	12.5		60.2	16.0		108.3	52.3	
	- LDPE	11.4	0.9		9.4	1.2		9.3	1.6		21.8	5.4		82.7	45.4		66.5	45.6	
8	Polyplropylene	62.5	34.5	17.9	74.0	41.6	17.3	74.4	50.3	17.7	88.5	57.2	43.3	91.2	60.5		91.4	60.8	
9	PVC	185.3	141.0	6.8	234.1	196.8	17.1	242.8	178.8	22.3	258.5	204.4	8.4	264.6	186.0		211.2	154.4	
10	Polyethers	40.9	34.9		65.5	58.0		87.5	71.3		97.8	80.3		107.0	88.8		115.2	94.7	
11	Oxo-alcohols	5.4	3.8		35.2	15.9		24.6	4.9		41.3	12.6		42.7	10.5		38.0	7.3	
12	Plasticizer																		
13	Benzene	41.4	19.3	-	63.4	46.2	-	79.8	53.9	0.3	72.2	74.4		57.3	56.7		53.9	50.5	
	- coking	15.1			14.0			12.0			7.0			6.5			5.9		
	- pyrolysis	21.2			20.1			20.0			28.7			27.6			25.3		
	- refinery	5.1			29.3			47.8			36.5			23.2			22.7		
14	Toluene	9.7	2.9	1.6	14.3	5.2	1.3	17.0	12.3	4.3	29.9	26.0	4.5	35.8	33.4		34.2	30.1	
15	Xylenes	1.1	-	1.5	3.5	-	1.3	2.1	-	3.0	1.8	-	2.6	0.2			0.2		

The production, export and import of petrochemical products in Romania, during 2003-2008 are presented in Table 2.1.

In the paper [3, 12] was described the restructuring of petrochemical industry in 1990-2008 period, so in this paper, we emphasize only the present situation, in 2010, from which can be analyzed the restructuring of this industrial branch vital to any modern economy.

When we talk about reorganization /restructuring the petrochemical industry in Romania has to start from what was left as being a functional technological unit (subchapt. 2.1.), from the availability of raw materials (subchapt. 2.2), from the domestic market requirement (subchapt. 2.3) and from the export possibilities of petrochemical products (subchapt. 2.4).

2.1. Petrochemical units in operation

In 2010, in March, the following base petrochemical units are still in running in Romania:

1. *Oltchim – Ramnicu Valcea*:

– Propenoxid-propyleneglycol	120,000 t/year
– Propyleneglycol	10,000 t/year
– Flexible polyols	100,000 t/year
– Rigid polyols	30,000 t/year
– Polymer polyols	40,000 t/year
– Special polyols	35,000 t/year
– Oxo-alcohols	55,000 t/year

By propylene acquired from the country and from import.

2. *Petromidia – Navodari*:

– Polypropylene	90,000 t/year
– HDPE	100,000 t/year

By propylene from Petromidia refinery and imported ethylene.

Along with the shutdown of Pyrolysis 2 Unit (with a nominal capacity of 200,000 t/y ethylene) of Arpechim Pitesti, shutdown made by Petrom – OMV in November 2008 have been shut down all the ethylene consuming units in Arpechim platform: high pressure polyethylene – 80,000 tons/year, low pressure polyethylene – 30,000 tons/year and ethylene oxide – 35,000 tons/year, as well as units from Oltchim Ramnicu Valcea – vinyl chloride unit – 160,000 tons/year and the corresponding polyvinyl chloride.

In 2009, the shut down of pyrolysis unit of the Arpechim Pitesti which led to the closure of the last producer of ethylene in Romania, had disastrous consequences on the production of PVC from Oltchim, as also on production of polyolefins (HDPE and LDPE) of Arpechim in terms of overlap with the economy general crisis installed in Romania, since the fourth quarter of 2008.

You can not talk about petrochemical industry without a domestic production of ethylene.

The ethylene supply imported on sea way, can be a transition solution but with a difficult and a short life from the economical point of view.

From the table above, it follows that the Romanian petrochemical industry reached the lowest possible point, once with OMV – Petrom decision of closing the pyrolysis no. 2 unit of to Arpechim Pitesti.

The long negotiations of Oltchim to purchase the unit called Petrochimia Arges, which includes the pyrolysis unit no. 2, high pressure polyethylene, low pressure polyethylene and ethylene oxide was finalized on January 2010.

2.2. Availability of raw materials

There are two classes of petrochemical raw materials [4]:

- **Primary raw materials**:

– Crude oil
– Associated gases
– Natural gases
– Coal
– Bituminous shale
– Tarnished sands

- **Secondary raw materials or intermediate**:

– Lower olefins: $C_2 – C_4$
– Aromatic hydrocarbons: $C_6 – C_8$
– Synthesis gas: H_2/CO mixture.

From the primary sources of raw materials: the crude oil, the associated gases and the natural gases has a weight of more than 95% in the manufacture of petrochemical products, while the coal, the bituminous shale and tarnished sands can be used for the same purpose, but the manufacturing costs are much higher. The primary sources of raw materials are substances produced by nature and were not subject to any prior chemical transformations.

The secondary or intermediate materials are obtained from the primary ones, through physical and chemical processes.

- **The crude oil** is composed of: hydrocarbons (alcans, naphthene, aromatic compounds), non-hydrocarbonates compounds (the nature of organic sulfur compounds – organosulphides, the hydrogen sulfide/sulphuretted hydrogen is the only sulfur compound of inorganic the nature of inorganic present in crude oil /petroleum, nitrogen compounds, oxygen compounds) and metallic compounds: Na, Mg, Al, Fe, Vn and Ni under the form of salts form or organometallic compounds.

- **The associated gases** are present in contact or dissolved in petroleum and are obtained simultaneously with crude oil extraction. The associated gases from Romania have the following composition in volume percentage: methane 50.6 to 99.1; ethane 0.5 – 12.2, propane 0.2 – 8.3; butane 0.1 – 4.5; pentene 0.1 – 5.3; H_2S – lack, CO 0.4 – 4.6; CO_2 15.2 – 25.7.

The natural gases represents the non-associated gases consisting of light hydrocarbons and non-hydrocarbonates compounds contained in the fields/deposits which are not containing crude oil/petroleum.

The natural gases in Romania are characterized by a high content of methane and due to lack of H_2S, with the following composition in volume percentage: methane 96.89; ethane 0.92; propane 0.44; butane 0.26; CO_2 0.31; N_2 1.10 Romania still has proven crude oil reserves for about 25 years at the current level of extraction and the crude oil offer on the international free market is relatively stable at a price of 50 USD for a barrel of crude oil.

2.2.1. The crude oil

Not the lack of crude oil from domestic production or on the international market led to the distraction of petrochemical industry in Romania, but the lack of medium-term strategic vision, which have shown all governments after 1990. A definite proof, in this way, is represented by the economic policy of former communist countries of Central and Eastern Europe (Poland, Czech Republic and Hungary), who has lack of crude oil reserves, but after 1990 they have developed the petrochemical industry, whose production increased about 4 times during 1990 – 2008.

The lack of economic vision especially from the way in which is used the crude oil bought on the domestic and international market, thus, compared to a total crude oil processing in Romania of approx. 19.5 million tons in 2006, of which 4.5 million tons from the country and 15 million tons from import, the domestic market consumes only about 8 million tons of fuel and the rest of 11.5 million tons is exported as a fuel. Here is reflected the low level of recovery of the imported crude oil, which is exported as a fuel instead of being used in petrochemical industry, which raise of 2 to 3 times the value of imported crude oil, through the export of petrochemical products.

If we add, now, the loss of export, by selling of fuel instead of petrochemical products, with imports made by Romania to cover domestic needs of the basic petrochemical products, we have a true picture of powerlessness of the policymakers to elaborate a national strategy within the crude oil processing and of waste which is made in connection with crude oil processing.

"Strategies of opportunity" are deceiving the gain realized by the State from other excise duty and fuel taxes which are applied, without taking into account the value lost by the fact that is stopped the crude oil recovery at the gate of the refinery and by the fact that there is no production for the domestic consumption and there is no exports of petrochemical products.

2.2.2. The associated gases

The predominant component in the associated gases is methane but the heavier hydrocarbons, C_{2+} cut are recovered in liquid form and represents a valuable raw material for petrochemical industry for the pyrolysis of hydrocarbons

in order to obtain ethylene. Propane and butane are separated from associated gases and is recovered in the form of LPG – liquid petroleum gas.

2.2.3. The natural gases

Current natural gases reserves of Romania are limited, being estimated at about 185 billion of cm and the annual production is about 12 billion cm (70% of domestic consumption) being in a sharp decline, leading to the need for gas imports of about 30% in order to cover the energy consumption (domestic and industrial) and the production of fertilizer for agriculture.

Liquefied natural gases (NGL) are those hydrocarbons heavier than methane (C_{2+}) that can be recovered from the natural gas. They are liquefied and then split in order to obtain three valuable petrochemical materials, namely: C_2 cut, rich in ethane, which is used as raw material for pyrolysis, liquefied petroleum gas (LPG) used either as raw material or as a fuel for petrochemical industry and natural gasoline (NG) – which consists mainly of C_{5+} hydrocarbons, which are usually added to correct motor gasoline distillation curve, especially for increasing the vapor pressure and decreasing the initial boiling point.

Other basic petrochemical raw materials (coal, bituminous shale and tarnished sands) have a much smaller importance, both worldwide and in our country, too.

2.2.4. Secondary or intermediate petrochemical materials

The secondary or intermediate petrochemical materials for Romania, that are important, are the inferior olefins $C_2 – C_5$ and aromatic hydrocarbons.

- The thermal cracking units of hydrocarbons under low pressure in the presence of steam, the so-called pyrolysis units (steam cracking units) is the main process from which $C_2 – C_5$ lower olefinic hydrocarbons are obtained.

Unfortunately, Romania has not operated any pyrolysis unit since November 2008, when OMV – Petrom closed the last unit Pyrolysis no. 2 of Arpechim Pitesti – 200,000 t/year of ethylene, which was in running continuous since 1975 until its shutdown.

The other pyrolysis unit with the same nominal capacity, from S.C. Petromidia S.A., could be rehabilitated, but was shut down in 1993.

- The aromatic hydrocarbons most important for the petrochemical industry are: benzene, toluene, ethylbenzene and mixture of xylenes (ortho, meta, para-xylene).

The main sources for obtaining aromatic hydrocarbons from pyrolysis gasoline (about 45% aromatic hydrocarbons) and the processes of catalytic reforming of heavy gasolines of crude oil refineries as well as from the specific processes of aromatization of the olefins hydrocarbons.

In the current conditions in Romania, when there is no pyrolysis unit in running, the only source of aromatic hydrocarbons is represented by the catalytic reforming gasolines from petroleum refineries, where these units are still in use. From the reforming gasolines, the aromatic hydrocarbons are obtained by extractive distillation with selective solvents.

2.3. Internal market requirements

The current requirements of petrochemical products of the internal market in Romania are handled mainly from import, taking into consideration that at present there is no production of polystyrene, polyvinyl chloride, phenol, acetone, acrylonitrile, butadiene, SBR rubber, polybutadiene rubber, nitryle rubber, polyisoprene rubber, ethylene oxide, monoethyleneglycol, ABS (acrylonitrile butadiene styrene copolymer), acetonitrile, latex, hydrogen cyanide, sodium cyanide, maleic anhydride, ethanol amines, alkylphenols, acetaldehyde, acetic acid, vinyl acetate, polyvinyl acetate acetic anhydride polyvinyl alcohol, polycarbonate, bisphenol, carbon black and still many basic petrochemicals which Romania has currently produced before 1990.

Also after1990, when the production of dimetiltereftalat, acetonitrile and phenol was stopped, in the same time was abolished the production of chemical fiber and threads (polyesther, polyacrylic and polyamide) after the privatization and dismantling of the factories: Fibrex Savinesti, Melanie Savinesti, Terom Iasi, Firmelbo Botosani, Polirom Roman, Moldosin Vaslui, Carapet Corabia and Grulen Campul Lung Muscel.

The consumption of petrochemical products used per capita in Romania is the lowest in Europe, about 4 kg, while in Western Europe the average is 14 kg and in Central European countries, former communist countries, is about 6 kg.

From what was previously presented, it can be easily inferred that there is a domestic market for the petrochemical products, market which meanwhile has been partially invaded by similar products imported from Hungary, Czech Republic, Poland and other countries which, has no crude oil resources, but they have developed the petrochemical industry after 1990.

2.4. External market requirements

After a relatively small period of time, due to CMEA market disappearance, after 1990, the petrochemicals market experienced a real boom proved from economically point of view by the Central European countries which have developed petrochemical industry into an accelerated rate, recovering the traditional Romanian markets.

The potential markets for sales of petrochemical products, as industry restructuring and revitalization of the polymer and petrochemical products are: European Union market, Central and Eastern Europe, Turkey, North Africa region, Balkan countries and especially China and the South East Asia.

3. RESTRUCTURING STAGES

Starting from the current state of petrochemical industry in Romania, from the raw material resources, the internal and external market demands, but even from the possibility of financing of these far-reaching investments that should be achieved, we believe that the restructuring and revitalization of petrochemical industry should be done in three distinct and successive stages, as follows:

3.1. Restructuring on short-term – 2010

During this period, is expected the restarting of technological units from Petrochimia Arges.

The memorandum which was initiated by the Ministry of Economy and was signed by the Prime Minister Emil Boc in June 2009 was approved for:

1. The granting of a bank guarantee in value of Euro 49.6 million by Exim Bank, guarantee which is necessary for S.C. Oltchim S.A. in order to obtain a loan in value of Euro 62 million, which will be used for:

I. The acquisition from S.C. Petrom S.A. of the related assets of the petrochemical unit belonging to Arpechim – Pitesti

II. The technological units overhauling necessary in order to restart the petrochemical unit

III. Ensuring of a working capital.

2. The increase of share capital of S.C. Oltchim S.A. by converting the AVAS debt into shares, in value of 538,336,541 lei, i.e., about Euro 134,584,135, with the preference right granted to minority shareholders, and

3. The granting of state guarantees in the amount accumulated up to Euro 339.2 million needed by S.C. Oltchim S.A. for bank loans, in cumulated value of Euro 424 million, to achieve the investment program during 2010 – 2012.

Short-term restructuring should include the following actions:

1) Mechanical overhauling of petrochemical units from Petrochimia Arges, namely:

- The pyrolysis unit/plant no. 2 with a nominal capacity of 200,000 t/y of ethylene, 100,000 t/y of propylene and other basic petrochemical products
- The unit of low density polyethylene, LDPE, with a capacity of 80,000 t/y
- The unit of high density polyethylene, HDPE, with a capacity of 30,000 t/y
- The unit of ethylene oxide and glycols, with a capacity 35,000 t/y of ethylene oxide.

The overhauling of Arpechim petrochemical units might be effected in March – May 2010 and the restarting should be performed at the end of May 2010.

The flow sheet of Petrochimia Arges is shown in Figure 3.1.

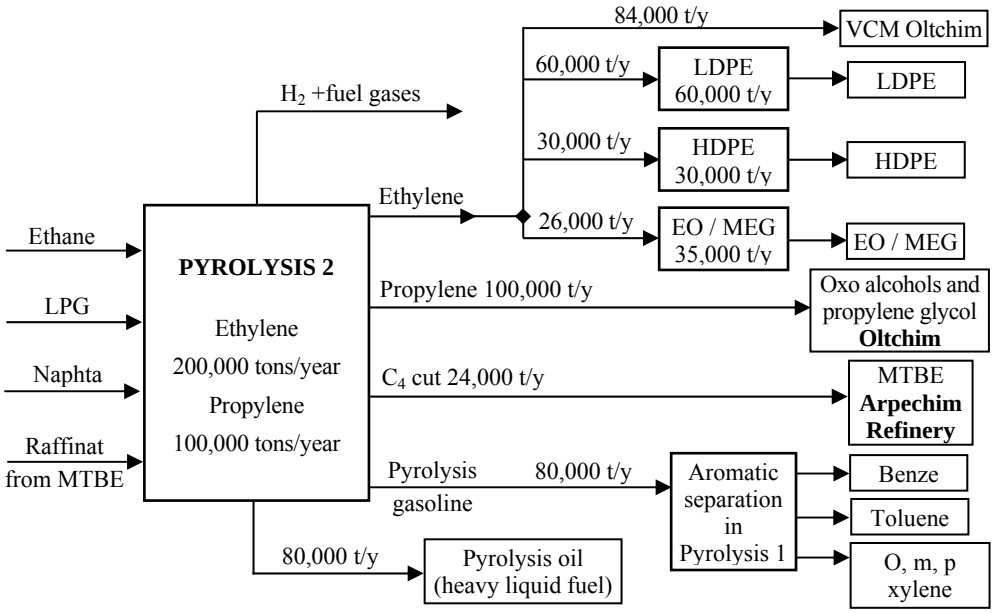


Fig. 3.1. The flow diagram of Petrochemical Arges.

Material balance sheet. A material balance can be made only after you know the structure of raw materials for the pyrolysis unit, because their nature and composition of liquid and gas depends on liquids traffic and gases as well as the final yields of reaction products.

2) The restating of pyrolysis unit no. 2 and of the ethylene consumers in Arpechim, will result in significant reduction of polyolefins import of Romania: LDPE, HDPE and PS, imports amounted in 2008 to about 50,000 t/y LDPE, 35,000 t/y and 80,000 tons/year polystyrene and in 2009 the imports increased even more, once were stopped those three units of Arpechim.

Currently, the only producer of LDPE from Romania is Rompetrol Petromidia, which has the plant in running, but the cost of polymer is higher due to the fact that raw material – liquefied ethylene is brought on liquefied state, by sea.

The pyrolysis from Rompetrol – Petromidia, with a capacity of 200,000 t/y ethylene, is shut down, since 1990 decade and there is small chance to be restarted on short term.

The new owners, Kaz Munai Gas do not considered as a priority the investment in modernization of the Petromidia pyrolysis unit, although there is a wide documentation of "Basic Design" for the revamping and modernization of the unit, elaborated by Linde AG. The investment value for the modernization of the pyrolysis unit/plant of Rompetrol Petromidia is estimated to Euro 340 million, including the technological equipment and the assurance of utilities.

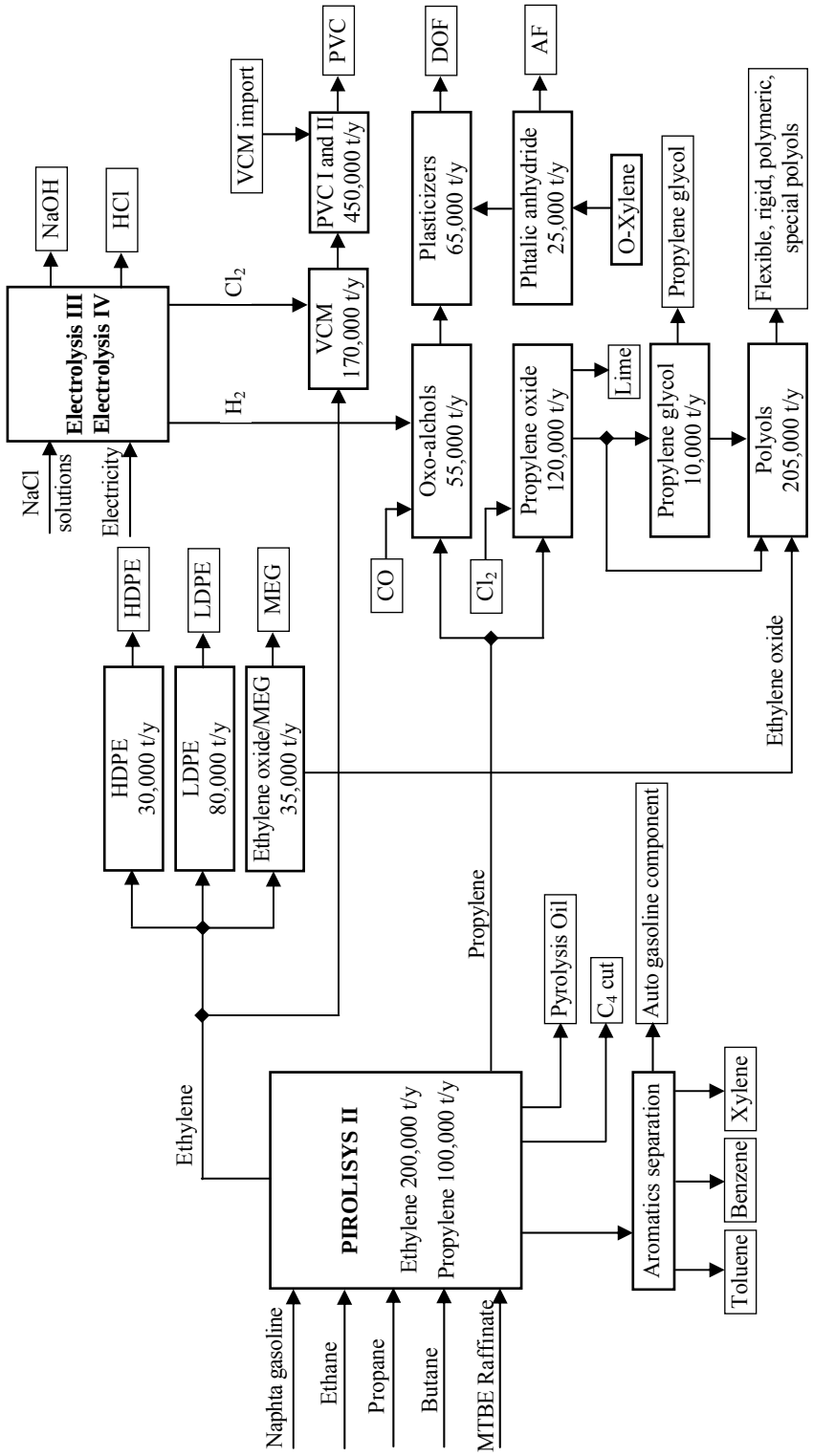


Fig. 3.2. The integrated flow diagram Arpechim – Oltchim.

The restarting of pyrolysis unit/plant in Arpechim will make possible the restarting of the and following technological units from the S.C. Oltchim S.A., units which were shut down in the absence of ethylene, since November 2008, namely:

- VCM – 170,000 t/year
- PVC II – 325,000 tons/year (and with 155,000 t/year import VCM)
- Electrolysis III mercury – 210,000 t/year of lye
  – 186,060 t/year of gaseous chlorine

(Electrolysis III had to be shut down once stoped the main consumer of chlorine, which is the vinyl chloride unit/plant)

- Phthalic anhydride – AF – 25,000 tons/year
- Plastifiers unit – DOF – 65,000 tons/year.

The consumers of propylene namely propenoxide, propylene glycol and oxoalcohols were not mainly influenced by the shut down of Pyrolysis 2 unit of Arpechim, because the propylene can be supplied from the country and can be imported as liquid propylene, by railway tanks. However, the propenoxide production, propylene glycol, polyols and the oxoalcohols was influenced by the economic crisis which induced a decrease in consumption of these products on external market.

Figure 3.2 presents the integrated working scheme Arpechim – Oltchim.

With the acquisition of Petrochimia with the restarting of Pyrolysis 2 unit, more than half of the number of technological units of S.C. Oltchim S.A. will be restarted without notable investment effort, but with proper mechanical overhaul of the technological units which were shut down last year.

3) The restarting of PVC production from Oltchim and of the other related units will have beneficial economical effects on the volume of sales by maintaining the traditional customers from Europe, Middle East, North Africa and China and open other new markets for products manufactured by Oltchim. It is noted that after the first stage of integration of Oltchim with Arpechim the chance of restructuring of the Romanian petrochemical industry became a reality, Romania will decrease the import of basic petrochemicals and goods consumer related to plastomers and elastomers.

Conclusions of the stage. During the restructuring on short term, the petrochemical sector in Romania should have in operation the following installations:

A. Pitesti – S.C. Petrochimia Arges – part of S. C. Oltchim S.A.:

1. Pyrolysis 2 unit/plant, with capacity of 200,000 t/year ethylene and 100,000 t/year propylene;
2. High pressure polyethylene unit HDPE – 30,000 tons/year;
3. Low pressure polyethylene unit LDPE – 80,000 tons/year;
4. Units of ethylene oxide and glycols EO/MEG – 35,000 tons/year.

B. At S.C. Oltchim S.A. could RUN all technological units presented in Figure 3.2:

B.1. Units/plants stopped because of lack of ethylene supply from Arpechim

5. VCM vinyl chloride unit/plant – 170,000 t/y;

6. Unit/plant of polyvinyl chloride PVC – 2: 325,000 tons/year (additional VCM from imports);

7. Electrolysis III – mercury 210,000 t/y lye and 186,000 t/y gaseous chlorine;

8. Phthalic anhydride plant A.F. – 25,000 tons/year;

9. Plastifier plant/unit DOF – 65,000 tons/year.

B.2. The technological units were not affected by the shut down of pyrolysis unit from Arpechim but were affected by economic crisis

10. Membrane electrolysis NaOH – 120,312 t/y, gaseous chlorine – 106,776 t/y;

11. Propenoxide – 120,000 tons/year;

12. Propylenglycol – 10,000 tons/year;

13. Flexible polyols – 100,000 tons/year;

14. Rigid polyols – 30,000 tons/year;

15. Polymer polyols – 40,000 tons/year;

16. Special polyols – 35,000 tons/year;

17. Oxoalcohols – 55,000 tons/year;

C. Rompetrol-Petromidia

18. Polypropylene plant (with propylene from catalytic cracking of its own refinery) PP – 100,000 t/y;

19. Low pressure polyethylene plant/unit (with imported ethylene) LDPE – 60,000 tons/year, after the mechanical retrofitting due to the fire from 2009.

20. High pressure polyethylene plant HDPE – 100,000 t/y (with imported ethylene).

In total, would be in running and could produce a total of 20 petrochemical units with a major production which would help to reduce the deficit of import – export chemicals balance.

3.2. The restructuring/reorganizing on medium term (2010 – 2012)

From the very beginning, we mention that on the short and medium term, the traditional petrochemical platforms (Petrobrazi – OMV DOLJCHIM – OMV, Petrotel – Lukoil, CAROM – Onesti) are not taken into consideration for the development of petrochemical industry, especially because of the new strategy of the owners who have closed down all the petrochemical plants that existed at the time of privatization.

The medium-term restructuring refers to investments which should be made during the period 2010 – 2012, over three years, on the petrochemical platforms: Petrochemicals – Arges, Oltchim – Ramnicu Valcea, Rafo – Onesti and Rompetrol – Petromidia. In the basic petrochemical field and of the refineries with the destination for the production of petrochemicals as raw material (the so called refineries without gasoline), only four more platforms must be taken into consideration today, for the development on medium term, namely: Oltchim – Ramnicu Valcea, Petrochimia – Arges, Rafo – Onesti and Rompetrol – Petromidia.

3.2.1. Petrochemicals Arges

A vital center of development on the medium term will have an increasing capacity and upgrading/modernization of pyrolysis 2 plant from 200,000 tons/year to 300,000 tons/year of ethylene.

Figure 3.3 presents the flow sheet of the platform Petrochimia – Arges, concerning its medium term development stage, respectively 2010 – 2012.

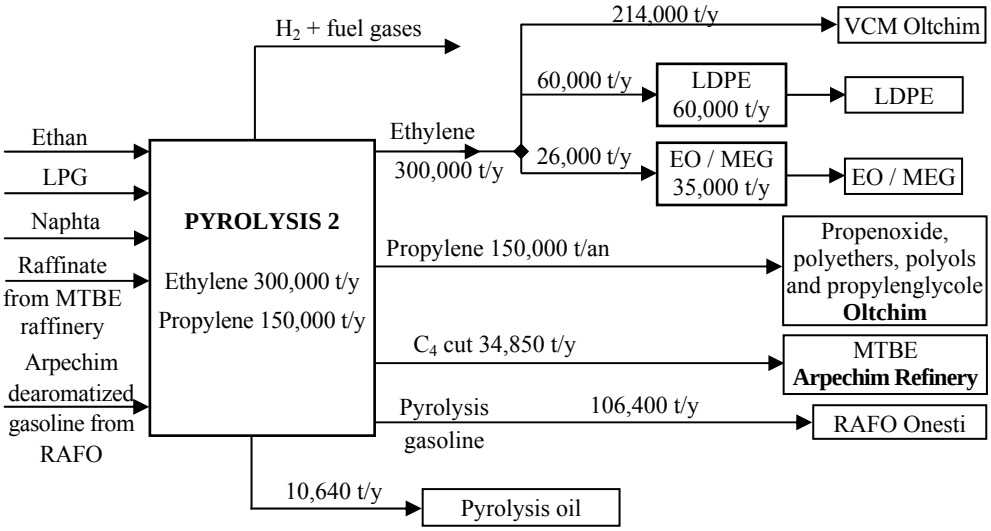


Fig. 3.3. The flow sheet of the platform Petrochimia Arges, concerning its medium term development stage, respectively 2010 – 2012.

Material balance sheet. A correct material balance sheet can be done only after will be established the raw materials structure necessary for the pyrolysis plant as a result of its capacity increase and modernization, because of their nature and composition, the traffic of liquid products and gases depends as well as the final yields for the reaction products.

The increase of the capacity, but mostly its modernization, shall lead to the decrease of the raw materials and energetic specific consumptions, to the products quality improvement, to the increase of the operation safety degree and to the reduction of the gaseous, liquid and solid pollutant emissions.

The investments volume necessary for increasing the capacity and for the modernization of the Pyrolysis plant no. 2 amounts to Eur 116 million, estimation based on feasibility studies made by prestigious companies, as Shaw Stone Webster, USA.

It has to be mentioned that after increasing the capacity of the pyrolysis plant from Petrochimia Arges, the quantity of ethylene that shall be delivered to Oltchim shall increase from 84,000 t/year to 214,000 t/year in order to increase the vinyl chloride production and it is estimated the closing of the high density polyethylene production.

Moreover, this is the moment when the cooperation between Oltchim – Petrochimia Arges and Rafo Onesti starts and within which the pyrolysis gasoline

shall be sent to Rafo Onesti, for the aromatic hydrocarbons to be extracted and Rafo shall send the de-aromatized pyrolysis gasoline back to Petrochimia Arges, in order to be used as raw material for pyrolysis.

The integration between Petrochimia Arges and Oltchim also aims the propylene supply of the consumers within Oltchim – propenoxide, propylene glycols and oxo-alcohols, plants that currently Oltchim provides with propylene from the domestic and import markets.

Oltchim integration with Petrochimia Arges shall permit the increase of the production of propylene glycol and polyethers polyols, highly agreed on the European Union market.

The transfer of some increased quantities of ethylene and propylene from Petrochimia Arges to Oltchim supposes the replacement of the current underground pipes (built between 1966 – 1967) having a length of approximately 80 km through which ethylene is transported under gaseous state, in some very critical conditions (25 °C and 35 bar) and propylene under liquid state.

The investment effort necessary for the replacement of those two underground pipes for ethylene (219×7 mm) and for propylene (105×5 mm) is amounting to Eur 20 million, the pipes following to be carried out on the same route as the existing ones.

3.2.2. S.C. Oltchim S.A.

During the 2010 – 2012 stage the following capacity increases and new plants are estimated, and for which Oltchim disposes of state guarantees as per the Memorandum initiated by the Ministry of Economy, amounting to Eur 339,2 million, in order to get bank credits totally amounting to Eur 424 million:

	Investments volume
• Modernization of the mercury electrolysis plant, by its conversion into membrane electrolysis	Eur 80 mil.
• New VCM plant with a capacity of 450,000 t/y	Eur 170 mil.
• Investments for the environment protection	Eur 38 mil.
Total Oltchim	**Eur 288 mil.**

For the medium term investments program the section from Petrochemicals Arges totally needs Eur 116 million, the replacement of the ethylene and propylene pipes – Eur 20 million and Eur 228 million at Oltchim, means a total of Eur 424 million.

Figure 3.4 presents the Petrochemicals Arges – Oltchim Rm. Valcea integrated operation flow sheet, as of the year 2012, after increasing the capacity of the Pyrolysis plant number 2 at 300,000 tons/year.

The Arpechim – Oltchim integrated flow sheet reflects the structure of a modern petrochemical plant that shall include in the fabrication profile: law density polyethylene, vinyl polychlorine, propenoxide – propylene glycol, prepolymers, rigid polyols, oxo-alcohols, phthalic anhydride, plasticizing agents, chlorosodic products, caustic soda lye, caustic soda flakes, caustic soda pearls, gaseous chlorine, doors and windows profiles, etc.

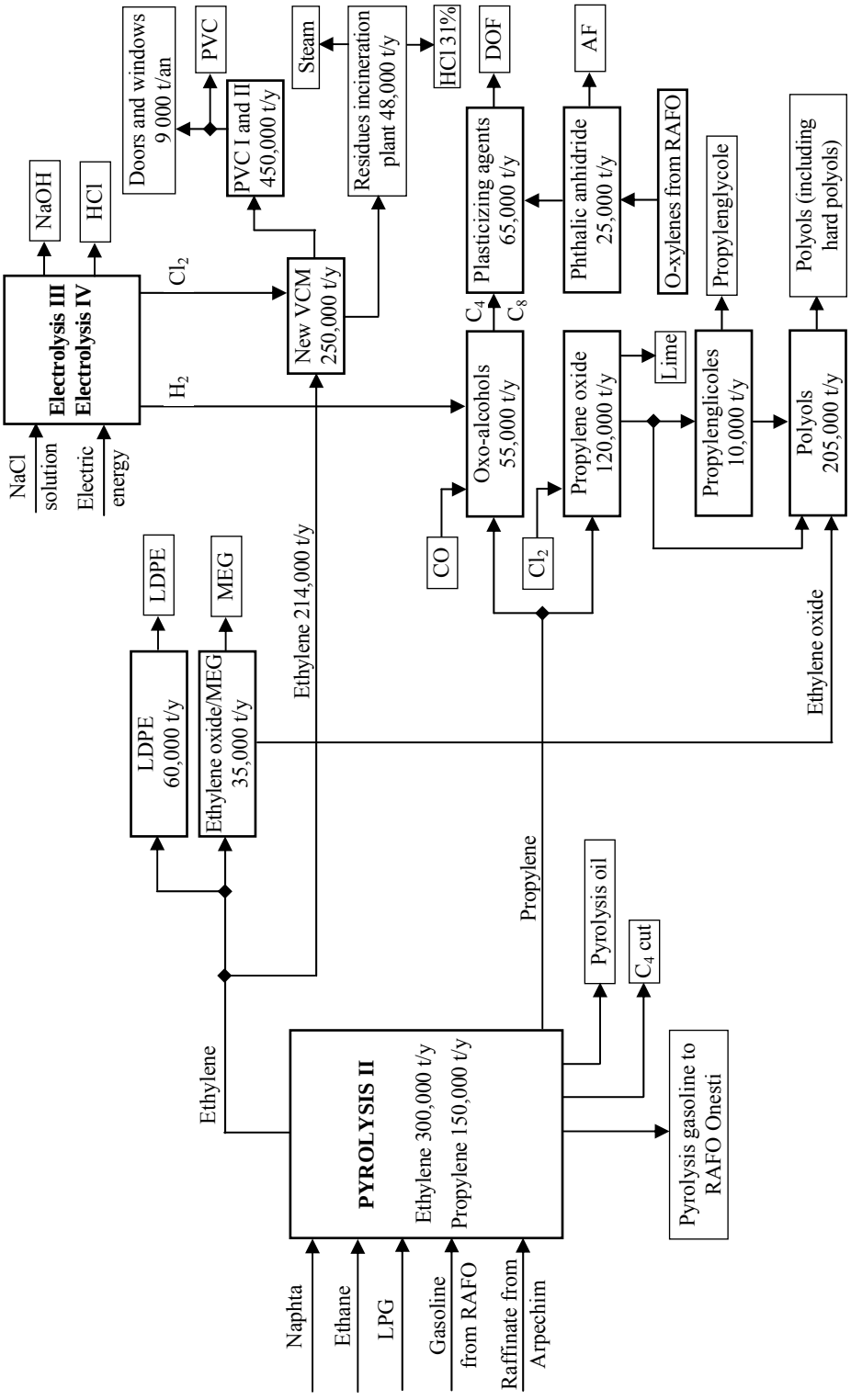


Fig. 3.4. The integrated flow diagram Arpechim – Oltchim 2012.

Oltchim receives the basic raw materials, ethylene and propylene, from its section Petrochimia Arges and transforms them into petrochemical products that are used on the domestic market and which are also exported.

The variety of the products (olefins, polyolefins, copolymers, polyols, plasticizing agents) that are to be obtained from the integrated unit Oltchim – Arpechim, shall increase unit's competitiveness considering the economic crisis conditions, thus being more easily to adapt to the market requirements.

This technological and administrative integration between the two units comes to confirm the 70' original conception, when those two units were ideated with complementary fabrication profiles.

The turnover and the economic efficiency of those two units shall be improved by the estimated integration, as a result of the production capacities adjustment to the limits resembling to those existing within the European Union.

3.2.3. Rafo Onesti

Rafo Onesti was set up, as a trading company, based on the Law no. 15/1990, being registered within the Trade Register Office from Bacau County under the no. J40 – 04 – 538 from 1991, on the date of 25th of March 1991. On that date, the company had two integrated type refineries in operation that started in two different stages as follows:

– A small refinery, with a capacity of 850,000 tons/year, put into operation between 1950 – 57, made for processing the domestic non-sulfurous crude oil

– A large refinery, for processing the imported sulfurous crude oil, with a capacity of 3.5 million tons/year, which was put into operation between 1970 – 80.

Taking into account the geographic position of the refinery, it had from the very beginning its own regional market for selling the products in Moldavia, North Transylvania, and for export – Republic of Moldova, Hungary and Poland.

After 1990, Rafo Onesti privatization got through with an extremely difficult history, successively being owned by a lot of supposed possessors and passing through multiple judiciary litigations, during long periods of time, when its operation was stopped.

In October 2003, Balkan Petroleum Ltd. purchased the majority shares package and entrusted the S.C. V – V Trading Company S.A. with the company's management, the company passing through a quite difficult financial situation.

On the date of 12nd of July 2005, Calder A International Holding purchased the majority shares package and concluded a crude oil processing contract with the company Fairnet Services Ltd., from Cyprus.

In October 2006, the shareholder of Rafo Onesti, namely Calder – A International, that is part of the Austrian group Petrochemical Holding, presents the identification documents of the companies involved in the purchase of the majority shares package belonging to the refinery from Onesti.

Petrochemical Holding paid off all the refinery's historical debts to the Romanian state and presently it has a clear legal state.

Rafo Onesti can process 3 million tons of crude oil per year, in its fabrication profile the sulfurous crude oil being included, as well as non-sulfurous, classic

fuels as gasoline, gas oil, but also fuels for agrimotors, liquefied gases, light fuels, fuel oil, petroleum coke and sulfur, obtained through atmospheric and vacuum distillation processes, as well as through secondary processing processes, as: catalytic cracking, catalytic reforming, coking, gases desulphurisation, aromatic hydrocarbon isomerisation and extraction.

With a 9.54 Nelson index, Rafo Onesti is enlisted within the refineries having a medium processing complexity degree, needing major investments funds for the fuels production to meet the European Union requirements, aiming the reduction of the sulfur and aromatic hydrocarbons content.

The new owners of Rafo Onesti refinery, Petrochemical Holding GmbH (PCH) chose to revamp the refinery during 2010 – 2012 aiming its transformation into a modern refinery mainly producing aromatic hydrocarbons, rafinat designated for olefins production through the low pressure cracking procedure (hydrocarbons pyrolysis) and gas oil. It shall be what is called a "Refinery without gasoline", oriented towards getting some raw materials (refined) and intermediary petrochemical products (benzene, toluene, p-xylene) extremely looked for on the domestic market.

The figure below presents the material balance sheet necessary for the atmospheric and vacuum distillation section within Rafo Onesti before modernization, under a supply of 375 t/h and an operation time of 8,000 hours per year.

In the operation diagram of Rafo Onesti refinery, before modernization, there were provided plants built between 1970 – 1980, except the atmospheric and vacuum distillation unit and secondary processing units as: catalytic cracking, catalytic reforming, heavy residue coking, gasoline and gas oil hydrofining and other auxiliary units.

Rafo Onesti project provides the modernization of the FCC Unit (Fluid Catalytic Cracking) and its transformation into a DCC Unit (Deep Catalytic Cracking), through which increased yields of aromatic hydrocarbons can be obtained. The company Shaw – Stone – Webster from Houston, USA offered the procedure, starting from heavier and cheaper crude oil cuts and it is based on catalysts specific to the procedure and adjusted together with SINOPEC – China, this procedure being industrially verified within many plants carried out in China and Thailand.

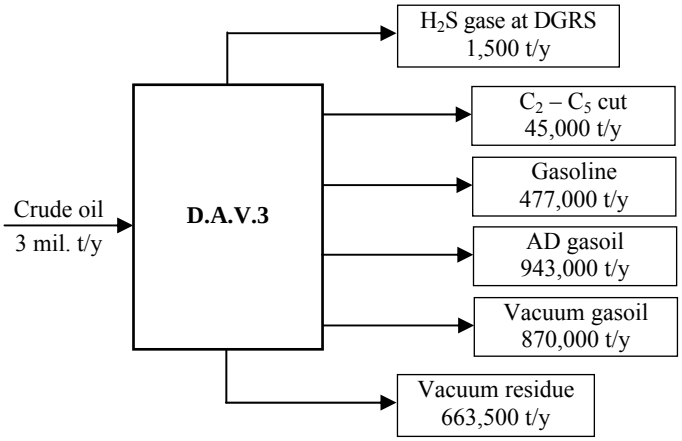


Fig. 3.5. The material balance sheet from DAV3 – Rafo Oneşti.

The procedures specific to aromatic hydrocarbons taking-out and separation make the object of a project, "Basic Design", elaborated by GTC Technology from Houston, USA.

The technological processes that form the project are the following:

- Separation of $C_6 – C_8$ cut from the gasoline that come from the DCC Unit
- Hydrotreating of pyrolysis gasoline
- Separation of aromatic hydrocarbons and of sulfur content compounds from the $C_6 – C_8$ cut through the GT – BTXPlus procedure
- Hydrodesulphurisation in order to eliminate the sulfur and to saturate the olefins contained by the pyrolysis gasoline and the aromatic extract
- Aromatization of C_4/C_5 cut and of the refined supplying the DCC Unit, aiming to get aromatic hydrocarbon
- Fractionation of the reformed product in order to separate the $C_6 – C_7$ cut from the supplying reformed product and naphta hydration
- Aromatics extraction by extractive distillation from the $C_6 – C_7$ cut through the GT – BTX procedure
- Post-fractionation of the aromatic mixture in order to separate the high purity benzene and the toluene
- Xylenes fractionation system for the separation of C_8 cut which supplies the section for p-xylene getting and $C_9 – C_{10}$ cut transalkylation
- P-xylene separation by adsorption
- Isomerisation for the conversion of xylenes mixture in order to maximize the p-xylene production
- Toluene and $C_9 – C_{10}$ cut transalkylation in order to maximize the p-xylene production.

Applying the above mentioned procedures, concerning Rafo Onesti refinery, to a crude oil processing of approximately 3 million t/year and starting from the following **raw materials** that come from the own refinery and also from other sources:

– 483,000 t/y, reformed product come from the catalytic reforming unit;
– 403,000 t/y, gasoline from the DCC Unit;
– 227,000 t/y, $C_4 – C_5$ cut come from the DCC Unit;
– 92,000 t/y, pyrolysis gasoline from Arpechim;
– 70,000 t/y, aromatic hydrocarbons enriched cut, come from other sources.

Can be obtained:

– 243,000 t/year of high purity benzene;
– 446,000 t/year of high purity p-xylene;
– 240,000 t/year of refined product, raw material for pyrolysis.

Obviously, the refinery shall also produce gas oil, fuel gases, coke, sulfur, cuts specific to the crude oil processing, up to the quantity of processed crude oil.

It has to be specified that Rafo – Onesti disposes of state guarantees as per the Memorandum initiated by the Ministry of Economy, amounting to Eur 335 million, in order to get bank credits totally amounting to Eur 450 million for carrying out the investments provided by the 2010 – 2012 investments program.

Figure 3.6 presents the integrated flow sheet of the units Oltchim, Petrochimia Arges and Rafo Onesti.

The three units Oltchim, Petrochimia Arges and Rafo Onesti shall be able to perform a few exchanges between them, as it results from the figure 3.6, these exchanges leading also to efficiency increase for each of the units engaged for integration (Oltchim and Petrochimia Arges) and cooperation (Rafo Onesti).

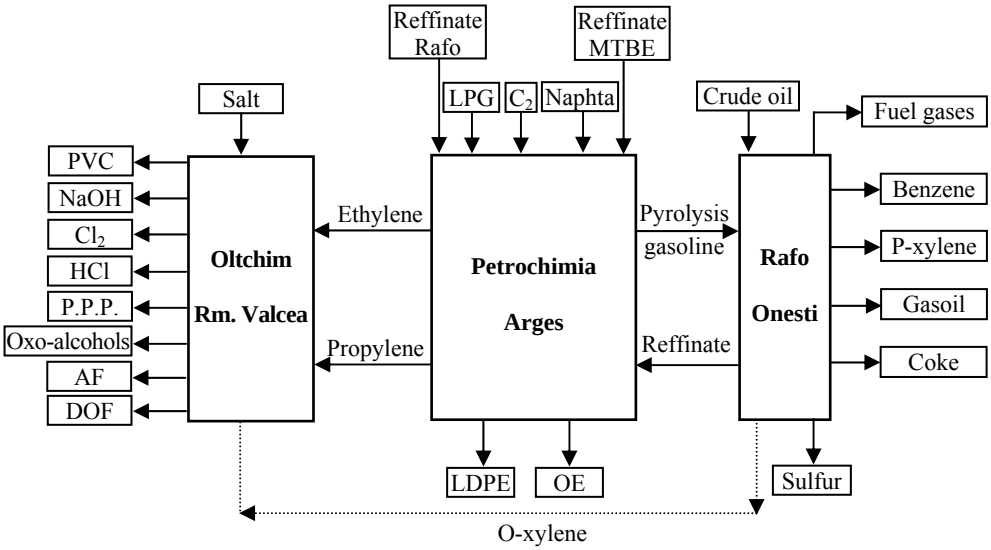


Fig. 3.6. Integrated flow sheet of the units Oltchim, Petrochimia Arges and Rafo Onesti.

Sending the pyrolysis gasoline from Petrochimia Arges to Rafo Onesti leads to investments savings for the modernization and capacity increase of the Pyrolysis Unit number 2 from Pitesti, and returning of the refined product from Rafo to Pyrolysis 2 shall lead to naphta import reduction.

O-xylene separation at Rafo can be introduced within the aromatic hydrocarbons separation diagram, thus Oltchim renouncing to import this product needed for the fabrication of the phthalic anhydride, and the increased supply with ethylene and propylene of Oltchim, as a result of pyrolysis unit capacity increase shall permit to increase the PVC and polyols export, transforming Oltchim into a market leader for the Central and Eastern Europe region.

Among the benefits of the integration Oltchim – Petrochimia Arges and the cooperation with Rafo, the returning to a level of the petrochemicals production close to the internal needs of Romania, recuperation of certain export markets lost after 1990 and rebuilding the development basis for the long-term stage worth to be mentioned.

3.2.4. Rompetrol – Petromidia

On medium term, 2010 – 2012, Petromidia could revamp the current pyrolysis unit, with the same production capacity, 200,000 tons/year, based on the basic engineering elaborated by Linde AG, Germany in 2009.

The relatively recent decision taken by the owner of Rompetrol – Petromidia, Kaz Munai Gaz consists in postponing the verdict regarding the implementation of the project elaborated by Linde AG, depending on the evolution of the economic recession felt also in Kazakhstan.

In case, in 2010, Kaz Munai Gaz would decide to revamp the pyrolysis unit from Petromidia, then the flow sheet is as presented by the figure 3.7.

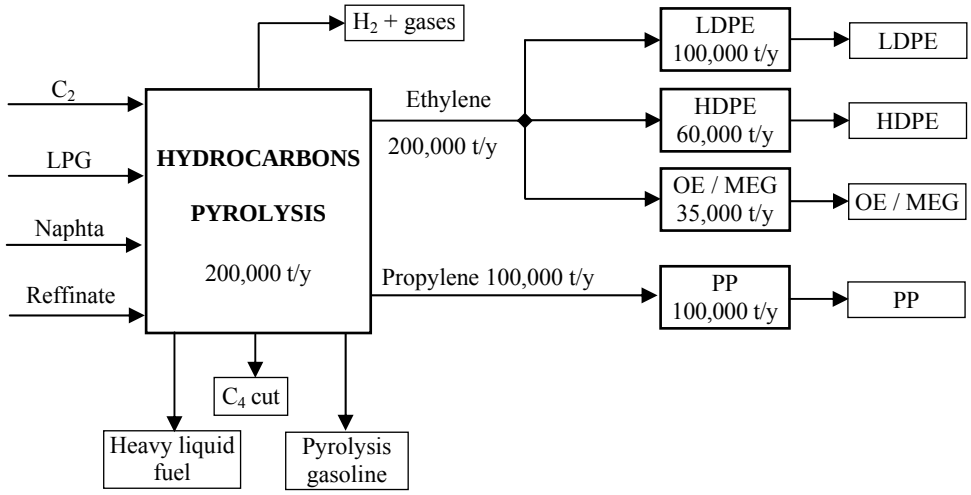


Fig. 3.7. Petromidia flow sheet (2010 – 2012).

The benefits from the modernization and restart of the pyrolysis unit from Petromidia shall be obtained from the reduction of ethylene onerous import from the basin of the Mediteranean Sea, from a better capitalization of certain own refinery products that shall be directed as raw materials for pyrolysis, such as: LPG, primary distillation gasoline and the dearomatized refined.

Pyrolysis revamp assumes investments amounting to Eur 340 million for the pyrolysis furnaces modernization, replacement of the damaged cold-box, replacement of some trays and columns internal, pipes replacement, control devices, utilities sources and distribution networks, etc.

It has to mentioned that in 1980 when Petromidia was designed and carried out, it was one of the most advanced refining-petrochemical unit from Romania. The petrochemical sector included, except the plants that survived until today (pyrolysis, HDPE, LDPE, PP and OEG) and the plants that were dismantled after 2000, along with the privatization by Rompetrol, such as: ethylbenzene, styrene propenoxide (the oxirane procedure) and DMT.

The strategic location of Petromidia refinery fully justifies the development of a petrochemical sector, due to its access to the maritime transport ways but also to the fluvial route, through the Danube – Black Sea Canal towards Central Europe.

3.3. Long-term perspectives, 2013 – 2015, for the modernization of the petrochemical industry

The petrochemical platforms fit for development are the ones previously mentioned to the modernization stages: Oltchim – Petrochimia Arges (after integration), Rafo Onesti (inclusively Carom Onesti) and Rompetrol Petromidia.

The petrochemical units completely dismantled by the new owners: Petrobrazi (OMV – Petrom), Petrotel (Lukoil), Solventul Timisoara, Copsa Mica, Negru de fum (Carbon Black) Pitesti and Doljchim Craiova (OMV – Petrom) do not have real chances to be rebuilt.

Carom Onesti could be an exception, meaning the reintegration within the production of the elastomers, phenol and acetone, once Rafo Onesti is transformed into a petrochemical refinery, on medium term.

The revitalization of the chemical threads and fibers sector presents a special situation, for which it is necessary that the raw materials to be assured from the basic petrochemistry sector, namely: the terephthalic acid, the phenol and the acrilonytril.

3.3.1. Oltchim – Petrochimia Arges

Romania shall have to come up with the countries from the Central and Eastern Europe (the Czech Republic, Poland and Hungary) that had developed their petrochemical industry after 1990, by building a new pyrolysis plant with a capacity of 700,000 t/year, located at Petrochemicals Arges, taking into account the integration with Oltchim and especially the privatization perspective for this new unit.

The development strategy of Petrochimia Arges could also take into account the integration with Arpechim Refinery, unit for which OMV – Petrom does not prove any interest in revamping and developing it, on the contrary, the intention is to relocate at Petrobrazi the newest plants carried out by Petrom in 2004, before privatization, namely the hydrogen plant and the vacuum gas oil hydrofining plant (VGO – HT).

After Petrom privatization, OMV carried out investments only within Petrobrazi Refinery, that it intends to bring to a refining capacity of the total production of the crude oil extracted from Romania as per the “Vision light” program.

Taking into account the trend at the world level, to increase the nominal capacity of the pyrolysis of hydrocarbons, up to the level of 1,400,000 t/year and the economic minimum limit of 500,000 t/year of ethylene, we propose that the future pyrolysis plant that could be built by the integrated company Oltchim at the section Petrochimia Arges to have a capacity of 700,000 t/year ethylene and 300,000 t/year propylene.

Figure 3.8 presents the flow sheet of a petrochemical complex based on a new pyrolysis plant with a capacity of 700,000 t/year ethylene.

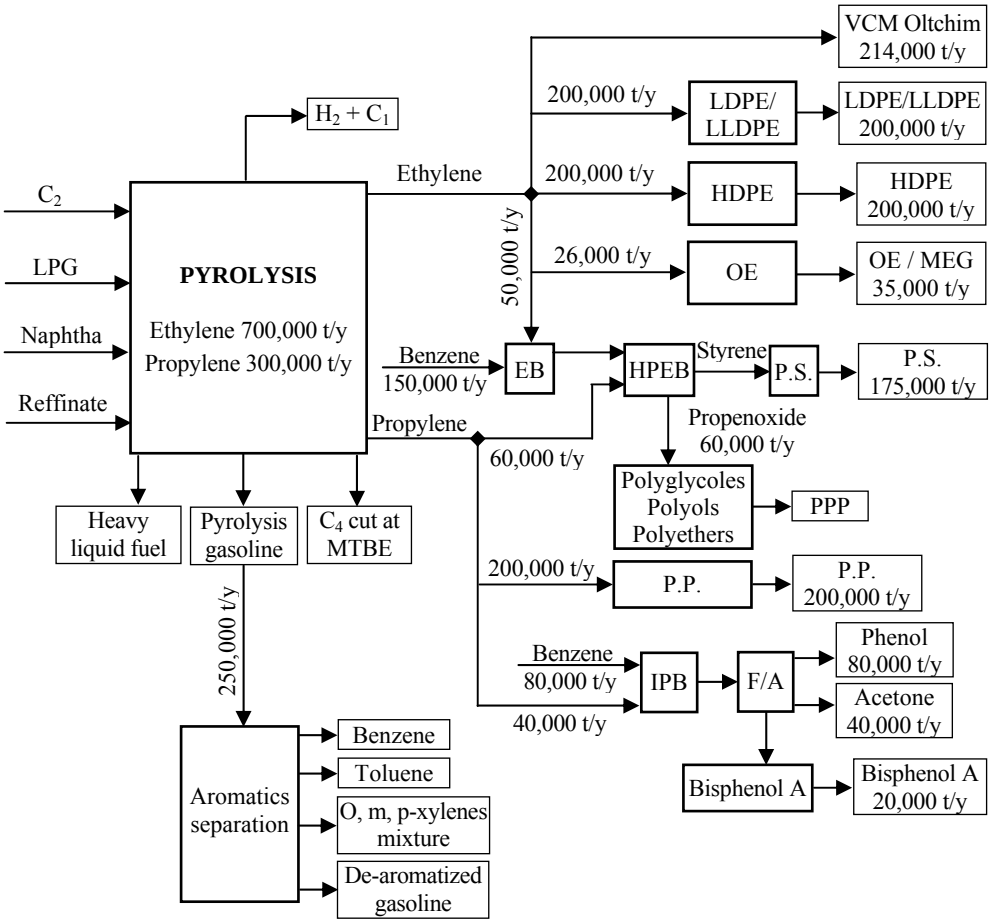


Fig. 3.8. The flow sheet of a new modern petrochemical complex.

Along with the starting of the new petrochemical complex within Oltchim – Petrochimia Arges based on 700,000 t/y ethylene, estimated after the year 2015, the present plants shall be stopped, namely: pyrolysis 2 and LDPE, HDPE unit was proposed to be stopped beginning with the medium term development stage, once the capacity increase of the current pyrolysis plant – 300,000 t/y is performed, simultaneously with the construction of a new VCM plant at Oltchim.

The production profile of the new petrochemical complex is characterized by:

- the coming up of the procedures technological level with the European technique level for hydrocarbons pyrolysis, high pressure polyethylene and low pressure polyethylene;
- the introduction within the fabrication profile of new petrochemical products, required both on the domestic market and on export: polystyrene, polypropylene, phenol, acetone, bisphenol;
- the introduction of the new process for getting the propenoxide, simultaneously with the styrene, makes possible to renounce to the current process,

applied at Oltchim, namely the propylene hydrochlorination, that is high pollutant and large energy consumer;

- increase of the production capacities of the petrochemical plants within the economic limits practiced by the European Union, thus making possible the competition with the Central Europe countries;
- increased possibilities to comply with the requirements of the foreign market through a larger production profile that covers the polyolefin, PVC, polystyrene, bisphenol, propylenglycole, polyethers, phenol, acetone, oxo-alcohols, phthalic anhydride, plasticizing agents and chlorosodic products.

The investments necessary for the accomplishment of such a program, as the one estimated for long term for Oltchim – Petrochemicals Arges, are presently difficultly to appreciate exactly, but the estimation with an approximation of ±30% can be done, as follows:

	Eur million
Hydrocarbons pyrolysis 700,000 t/year	750
HDPE 200,000 t/year	180
LDPE 200,000 t/year	150
EB/HPEB/PS 175,000 t/year	450
Polypropylene 200,000 t/year	160
IPB/FA 80,000 t/year / 40,000 t/year	70
Bisphenol 20,000 t/year	15
Total	**1,775**

There is also an alternative to the flow sheet of the new petrochemical complex namely, to further maintain in operation the Pyrolysis Plant number 2 from Petrochemicals Arges, after its modernization and capacity increase up to 300,000 t/year, in which case should exist an ethylene reserve in order to increase the PVC production within Oltchim, over the current capacity of 450,000 t/year, if the demand of the domestic market, but especially the export, justifies such action.

3.3.2. Rafo Onesti

The development intention of the company after the implementation of the program forecasted for the period 2010 – 2012 and previously presented at point 3.2.3. is presented within a development program estimated by Rafo Onesti [5].

Figure 3.9 presents the refinery's flow sheet, for a crude oil processing of only 2.6 million t/year, where the aromatic complex is dark gray colored (the 2010 – 2012 stage) and the subsequent development, 2013 – 2015 is gray colored.

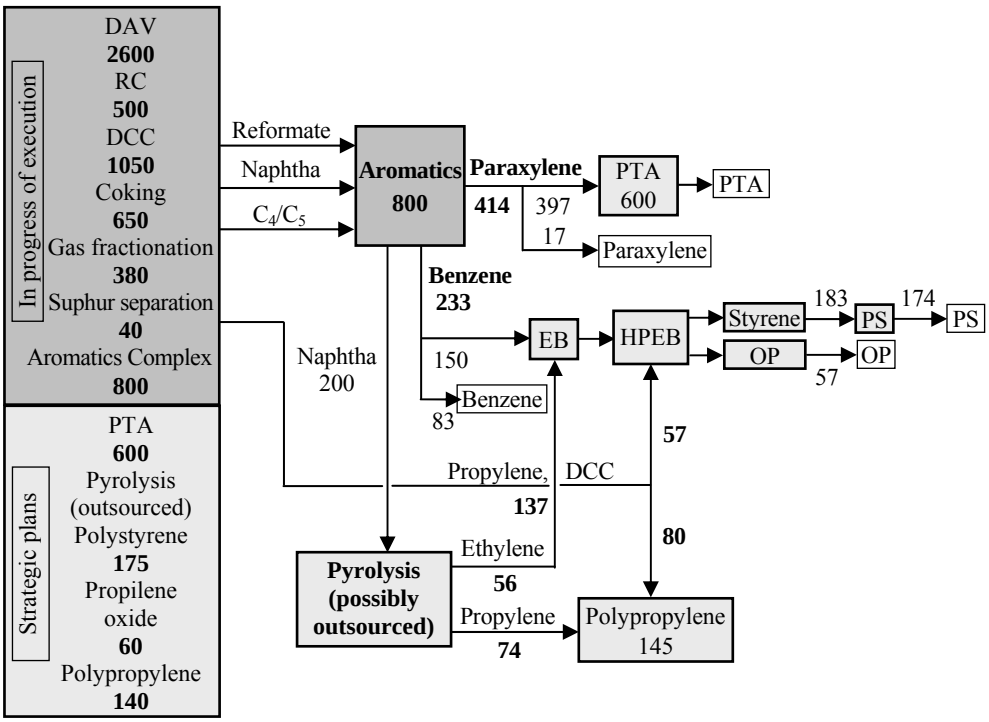
The new owner of Rafo – Petrochemical Holding, intends to develop a petrochemical complex based especially on own production of aromatic hydrocarbons of which to be produced:

– terephthalic acid (PTA) – 600,000 t/year, an intermediary product meant for the production of polyethylenterephthalat;

– styrene (183,000 t/year) and propenoxide through the hydroperoxidation (oxirane) which uses the reaction between the ethylbenzene hydroperoxide and propylene, simultaneously obtaining two very valuable basic petrochemical products;

– polystyrene 174,000 t/year, an extremely rare product in Romania and solicited in many fields but especially as expanded polystyrene in constructions and for buildings thermal insulation;

– polypropylene 145,000 t/year.



Products	The first stage (under achievement)	The second development stage
Diesel	1,080	1,080
Naphtha	246	46
LPG	252	262
Coke	157	157
Sulfur	23	23
Paraxylen	414	17
Benzene	233	83
Propylene	137	0
PTA	-	600
Polypropylene	-	145
Polystyrene	-	174
Propylene oxide	-	57

Fig. 3.9. Rafo Onesti flow sheet according to the development program.

For the forecasted development program, Rafo Onesti needs to introduce within the fabrication profile a small capacity hydrocarbons pyrolysis plant, with a very small production of ethylene – 56,000 t/year and propylene – 74,000 t/year, uneconomical at the level of the internationally used capacities. The possibility of the external supply is also uneconomical, as there are no sources fed with gaseous ethylene through an underground pipeline in the area and the transport of liquid ethylene involves a lot of difficulties related to the transport security and explosion danger.

Our recommandations are:

- To maintain in the development profile the manufacturing of the terephthalic acid, using p-xylene and polyethyleneterephthalate, with a large use in the production of bottles for alimentary liquids
- To keep in the manufacturing profile the polypropylene, a product with distribution market and that uses the propylene from the deep catalytic cracking unit
- To take out of the manufacturing profile the pyrolysis, the styrene and the propenoxide, Oltchim – Petrochimia Arges having a better position, as it has the necessary ethylene and also the experience accumulated in the propenoxide manufacturing, even in the case of propylene chlorhydrination.

More than that, through the collaboration protocol concluded with Oltchim, Rafo undertook to supply to Pyrolysis no. 2 from Pitesti the raffinate resulted from the extraction of aromatics from the pyrolysis gasoline coming from Pyrolysis no. 2.

- The investments saving that would occur by excluding the four large technological units from the manufacturing profile, namely the pyrolysis (small capacity and an unbalanced report between ethylene and propylene, of 1/1.36 as to the usual report of 1/0.5), ethyl benzene, propene hydroperoxidation and polystyrene, could be directed for the collaboration in the area with Carom Onesti, for the revitalization of the elastomers production.

The investment effort for the production profile reconsidered according to our proposal would be:

		Million Euro
Terephthalic acid	600,000 t/year	450
Polyethyleneterephthalate		
Polypropylene	145,000 t/year	120
Total		**570**

3.3.3. CAROM Onesti

CAROM Onesti has a long-standing experience in the manufacturing of synthetic rubbers: styrene butadiene (SBR), α–methyl butadiene, nitrilic and polyisoprenic as well as in the manufacturing of other petrochemical intermediates as: phenol, acetone, α–methyl styrene, isopropylbenzene, bisphenol, isobutene, butadiene a.o.

Currently, none of the above mentioned units is in production, several of them being demolished and sold as scrap iron by the new owners.

Restart of the styrene butadiene rubber production with the prior elaboration of a feasibility study taking into consideration the supply of the two basic raw materials, the styrene and the butadiene.

For the reactivation of the production of styrene – butadiene rubber in Romania, the options have been presented in the prior chapters and they refer to the platform Oltchim – Petrochimia Arges.

In the case of Rafo – CAROM it can be taken into consideration the production of styrene through the extraction from pyrolysis gasoline, coming from Petrochimia Arges and feeding the aromatics extraction group of Rafo Onesti.

The styrene content of the pyrolysis gasoline is quite high, 12.866%g, that means:

For a pyrolysis unit of:	Pyrolysis gasoline, t/year	Styrene, t/year
200,000 t/year ethylene	80,000	10,293
300,000 t/year ethylene	106,400	13,690
700,000 t/year ethylene	250,000	32,165

The separation of styrene from the pyrolysis gasoline can be performed within the departments of aromatic hydrocarbons separation from the pyrolysis gasoline at Rafo Onesti, this representing one of the modalities of collaboration with CAROM.

The other basic component in the structure of the SBR rubber is butadiene. For its production, the extraction from the C_4 cut coming from the pyrolysis units can be taken into consideration.

The butadiene content in the C_4 cut coming from the pyrolysis units is about 40%g, that means:

For a pyrolysis unit of:	C_4 cut, t/year	Butadiene, t/year
200,000 t/year ethylene	24,000	9,600
300,000 t/year ethylene	34,580	13,900
700,000 t/year ethylene	75,000	30,000

From the observation of the above data it results that the SBR rubber might be produced with raw materials from the country only after 2015, once a pyrolysis unit with a capacity of 700,000 t/year ethylene is commissioned at Oltchim – Petrochimia Arges department or earlier through the import of styrene and butadiene.

The above mentioned estimations cannot replace a feasibility study that would be necessary for the restart of the elastomers production in Romania. The feasibility study should take into account the other types of synthetic, nitrilic, polybutadiene and butilic rubber, except for the isoprene rubber, which is cheaper to use from the plantations of natural rubber.

3.3.4. Rompetrol Petromidia

In the current context, when the main shareholder Kaz Munai Gaz postponed for the second semester of 2010 the decision regarding the revamping and the modernization of the pyrolysis unit from Rompetrol Petromidia, it is difficult to forecast a program of petrochemical development of this unit after 2015.

Despite of the above, we have to underline the fact that due to the geographical position and the easy access to the maritime and fluvial ways, Petromidia benefits from the most advantageous conditions for the supply of raw materials and for products distribution, as compared with the other petrochemicals producers from Romania.

We can also mention that the narrow profile of polymers it produces (only polyolefins) and the small production capacities will not allow the long-term survival in the competition with the other producers.

From this point of view we believe that the decision Kaz Munai Gaz is to take in the second semester of 2010 will be either the modernization of the current pyrolysis unit with the capacity of 200,000 t/year ethylene or the increase of its capacity and the diversification of the manufacturing profile.

3.3.5. The sector of chemical threads and fibers

The sector of chemical threads and fibers in Romania is the industrial sector most affected after 1990. Victim of the basic raw materials disappearance from the production: phenol for the polyamidic fibres, dimethyl terephthalate for the polyestheric fibers and the acrylonitrile for the polyacrylic fibers, the disappearance of CAER (COMECOM) market and the unsuccessful preferential privatizations had as result the liquidation of this industrial sector in Romania after 1990.

The current condition of the units producing synthetic threads and fibers before 1990 is the following:

Table 3.1.

The status of the synthetic threads and fibers units

Unit	Owner	Current status
1. Fibrex S.A. Savinesti 23,400 t/year of polyamidic fibres	Radicci Group	*Decommissioned* Technological equipment decommissioned and sold as scrap iron
2. Melana Savinesti 45,000 t/year	AVAS	*Liquidation* Melana 2 + 3 completely decommissioned Melana 4, Owned by Rifil Italy accidentally processes threads imported from Italy
3. TERROM Iasi 55,000 t/year polyester fibers	AVAS	*Liquidation* Completely demolished, the land was parceled out for urban constructions
4. Firmelbo Botosani 3,000 t/year	RIFIL Italy	Shut down for three years and non-operating
5. Polirom Roman 18,000 t/year cord threads and networks	AVAS	*Liquidation* Shut off, non-operating
6. Moldosin Vaslui 12,000 t/year technical threads	AVAS	*Liquidation* Out of work and in demolition
7. Corapet Corabia 21,000 t/year polyester fibers	Concept SRL	*Liquidation* Completely demolished
8. Grulen Campulung 45,500 t/year polyester grains	Baschiria FR	*Dismantled* Demolished

The situation of each company is the following:

1) Fibrex S.A. Savinesti – Technological equipments dismantled and sold as scrap

2) Melana Savinesti – Melana 2 + 3 completely dismantled Melana 4, owned by Rifil Italy accidentally processes threads imported from Italy

3) TERROM Iasi – Completely demolished, the land was divided into lots for urban constructions

4) Firmelbo Botosani – Shut down for three years and non-operating

5) Polirom Roman – Shut down, non-operating

6) Moldosin Vaslui – Out of work and in demolition

7) Corapet Corabia – Completely demolished

8) Grulen Campulung – Demolished.

It is obvious that a revival of the Romanian staple fibers and grains sector for a long time may be carried out only by private investors with a financial power, taking into account the great investment values required by the rehabilitation of this sector.

The reconstruction of the sector should be preceded by the elaboration of a market study and of a feasibility study realized by companies experienced in the field of staple fibers and grains examining: the requirements of the internal and external market, the types of staple fibers and grains required by the consumers, the disposable raw materials from local resources and import, the evolution of the technologies applied in the staple fibers and grains industry in the European Union and world-wide and other aspects related to the development of this sector.

4. THE PREMISES OF THE REORGANIZATION

One of the most serious consequences of the petrochemical industry reorganization we mention the decrease of the number of specialists in the fields: research, designing and exploitation engineering body.

Together with the demolition of the production units, the total reduction of the investments in this field, the liquidation of some chemical-petrochemical research-development institutes, most of the specialists left the country in order to work abroad, or they have been put on the retired list before.

In the field of the operation personnel of the petrochemical companies, the situation is even more serious taking into account the personnel release, the anticipated retirement and the reorientation to other fields of the former employees.

The reorganization of the petro-chemistry should begin from the training in advance of a new generation of process operators, foremen and maintenance mechanics, in industrial schools with a specialized curriculum.

On the other hand, the exploitation engineering personnel feels the effects of the fact that the graduates from the chemical engineering faculties are unprepared in this field, faculties in which the subject “petro-chemistry” is no more studied, not mentioning the fact that there in no entrance examination at the Faculty of Applied Chemistry and Materials Science, the criterion being the school situation when leaving the high-school.

In the design units, organized for many years in the trade companies there are only few process designers, skilled and well prepared in using the calculation programs performant in the simulation of the technological processes.

For almost 20 years, after 1990, the design institutes have been focused on execution details, as sub-contractors for some foreign companies that elaborate the basic engineering. Even in this quality of sub-contractors for execution details, the Romanian design institutes have been involved more in the design of some storehouses, networks and utility sources and less within the limit of the proper technological battery.

The technological research units organized either in developing companies or within the universities with industrial chemistry faculties, Research National Institutes in the field of chemistry or institutes attached to the Romanian Academy, produced in the last 20 years no remarkable technological process patented and applied in the petrochemical or crude oil processing industry.

Important funds meant for research from national or European sources are “immortalized” in studies that have had no remarkable industrial application or obvious economical effects.

The reorganization of the petrochemical industry should also include the reorientation of the sector that contributes to its fulfillment and operation.

There are no schools for operators and foremen in the field of chemical and petrochemical construction and operation, mechanical maintenance and automatic control of the technological units.

4.1. In the field of the specialized human resources

The development of an efficient petrochemical industry in Romania is conditioned by the professional specialization and the permanent training of some well-qualified human resources both in the accomplishment of the production processes and the design activity in the research – development – innovation field. At present, in this field, there are important deficiencies (some of them pronounced in the last decades, contrary to the tendencies manifested in the world).

4.1.1. The preuniversity education [7]

The important part played by the medium education in the professional orientation is well-known. Nowadays, there is a pronounced decrease of the interest in the professions related to material production and especially in the chemical and petrochemical industry sector. This situation occurs as a result of an unfavorable combination of factors as for example:

- The constant and pronounced decrease of the study of natural sciences during high-school. With regard to chemistry there is a decrease of up to 20% compared to the share of this subject in 1990; at present, in most of the highschools, the time allotted to the study of Chemistry is reduced to less than 2% of the total. This is also the situation of the physics and biology, the subjects that should normally shape the youth interest in professions in the field of industrial and agricultural production. This situation, incompatible with EU recommendations for the youth stimulation for technical professions, mainly occurred due to subjective reasons related to the discretionary implication of some state employies in the place of the decisions made by competent and responsible authorities.

Proposal: we consider that the establishment of the share of the different curriculum areas in the pre-university education should be made by law, on the basis of the pertinent proposals of some highly competent boards.

- The quality evaluation in the pre-university education is very low even behind the superior education. The Chemistry National Board of MECI itself performs a sporadic activity, marked by conservatism and a limited general view. For example, the establishment of the analytical programs in the last four years was made, every year, for the IX^{-th} – XII^{-th} forms without having, from the very beginning, a unitary general strategy.

Proposals:

– the reorganization and modernization of the Chemistry National Board and the assurance of a systematic activity of this one, based on the competent analysis of the Chemistry study in the Romanian schools, as it results from the national experience, as well as compared to the one of the worldwide developed countries;

– the organization of a national agency in order to evaluate the quality of the high-school education;

– the organization (in collaboration with MECI – the Romanian Chemistry Society) of some dissemination activities of the valuable didactic experience in teaching and the study of Chemistry by students (conferences, symposiums, exchanges of experience at the national level).

- The high-schools specialized in the field of Chemistry are in a pronounced regress; the number of the interested students reduces; the quality and motivation of the students is lower and lower; instead of limiting these tendencies, the administration of the high-schools prefers to liquidate the Chemistry forms and change this section. Even if at the decisive political level this situation is well-known the state action levers for the necessary remedies in accordance with the national interest are not used.

Proposal: we consider that interest stimulation measures are necessary for the study in the industrial high-schools (especially Chemistry ones) by more scholarships and a privileged financing for the improvement of logistics and of the social-cultural conditions of these high-schools (boarding schools, canteens, sports grounds, cultural facilities).

- The youth education by activities having a scientific experiment feature is a way to discover the talent and the taste for the technical-scientific work, used a lot in different ways in the world: in some countries there are sectors of the science and techniques museums in which experimental activities for children are permitted and organized; in our country there have been work circles for children in the former pioneer and youth centers, at present disappearing rarities. Moreover, the school chemistry laboratories are almost unused because of the reduced number of classes in the curriculum, the shortage of materials and the restrictions regarding the holding and using of the reagents.

Proposals:

– the legal inclusion among MECI priorities of a campaign regarding the reorganization, equipment and use of the high-school chemistry laboratories; the attracting in this action of the trade companies in the field of chemistry;

– the elaboration of a manual of good practice in the activity of school laboratory, in accordance with the European norms.

4.1.2. The higher education

Even if the higher chemistry and chemical engineering higher education from Romania has won, in time, a good international reputation there are, at present, a series of aspects that have to be improved. Some of the most important and urgent are as follows:

- The basic financing remains unsatisfactory (in spite of the improvements in the last two years): in the chemical engineering higher education from Romania this one represents about 10% of the one granted in the west – European countries, respectively 5% of the one perceived by taxes in the universities from USA. A detailed argumentation is not necessary in order to understand that, if the material cost (equipments, substances, software, special literature) is the same, the scientific and even the educational performances from our universities may not be

equal to those of the universities in the advanced countries. This lagging behind is even more serious if we take into account the fact that the freedom of movement and the market open for the educational offer tends to keep the endowed young persons apart from the Romanian universities. That is already obvious at the level of the doctorate and post-doctorate studies.

Proposals:

– the financing increase of the chemical engineering higher education (and other specializations, depending on the national interest) by improving the amplification coefficient: at present this one is of 1.9 compared to 4-5 in west-European countries. The coefficient improvement may be gradually accomplished, in accordance with the budget increase, in this way not affecting other educational fields;

– the establishment of a university hierarchy depending on the performances quality (evaluation according to internationally practiced criteria) and the additional financing of the top universities, so as to be on honorable positions in the international classifications.

- The positive discrimination of the field of petro-chemistry education. This measure is necessary because of the temporary disfavored situation of this profession, for different reasons (production decrease, labor market, salaries that are not according to the difficulty of the tasks, incorrect publicity, mentioned effects of the pre-university education) massively reduced the number and quality of the students in the field of petro-chemistry.

Proposals:

– the allocation of a greater number of places with no school-fee for the petro-chemistry specialization (especially in the universities that are near the great beneficiary companies);

– the granting of additional scholarships;

– the assurance of some favorable socio-cultural conditions (hostels, canteens, sports grounds, students' arts centers);

– direct contribution of the main beneficiaries of the human resource, to its training.

- At present there is a totally counterproductive discontinuance between faculties and specific departments, on the one hand and the specialized trade companies, on the other hand. The lack of communication and collaboration is prejudicial to the interests of the both potential partners (for example, even the students' industrial training is a problem, so that in spite of normality the training strategies are more and more reduced).

Proposals:

– the creation and development of bilateral relations higher education-production having as objectives: the organization and endowment of students' laboratories, within departments, the organization of the students' production training, the organization of post-university courses for the industry personnel;

– the concluding of contracts between companies and students with regard to scholarships and the hiring, after graduating within the sponsor company;

– the promotion of the scientific research as education method.

• Within the master and doctorate studies, the scientific research is considered the main education method. At present, the efficiency of this strategy is affected by some deficiencies: the equipments that are not modern enough and sometimes deficiently managed (the insufficient and not very-well trained technical personnel, the use below its capacity, services for third parties that are not really possible); old and incomplete scientific documentation system; the scientific problems that are not according to the production priorities.

Proposals:

– the organization of a national technical library that assures a good documentation in the scientific and technical field (about 2,000 periodicals) using modern IT means. The promotion of a legislative regulation that assures the financing of this institution by drawing about 2% of the budgetary fund granted for RDI.

– the promotion of the research projects by departments-companies partnerships, and the implication, together with teacher, of the students attending master and doctorate courses. ANCS requirement to urgently improve the evaluation system regarding the fulfillment of the scientific obligations assumed by the public funds financed contacts.

4.2. In the research – development (R – D) field

In the East-European countries, after the fall of the centralized leading communist system, dramatic changes have been produced by the passing to the market economy and the adoption of the regulatory system of the demand-offer game. In Romania, even to a greater extent compared to the ex-“fraternal” countries, we have witnesses in the last 20 years a rapid deindustrialization process, the disappearing of some production branches and social-professional changes in big population groups having disastrous consequences for the live and evolution of some great areas of the national territory.

On the other hand, it is absurd to seriously think about the reversal of the historical evolution direction just to reuse the apparent “advantages” of the dirigible economy. We have to agree with the famous American teacher who was born in Romania, Nicolas Spulber, who said about the soviet economy that it had been a terrible mistake, but we can learn and understand many things from the data of this immense historical experiment. Paradoxically, nowadays, Romania with all the obvious economical failures, having to solve very serious problems determined by the complex process of transition to the free economy, there has not been used in a suitable and sufficient measure the intellectual potential of the technical staff trained in the “forced” industrialization period. Good or bad, the industrialization accomplished by the communist regime has determined the increase of the training level of some great population segments and permitted the occurrence of some important human resources, capable to integrate in the global economy of the serious generalized competition.

The research – designing specialists that took part in the process regarding the Romanian industry structuring should have assured with suitable solutions the coherence of the process regarding the transition, reorganization, renunciation to certain production types and the adoption of some others.

The maximizing of the profit and the increase of the capital accumulations have to be in accordance with the interests of the whole company, for a long period.

Not intending to formulate some ides that should determine the occurrence of some inadequate emotional conditions to some important actors in the life of the Romanian society, we have to say that the decision-making process regarding the reorganization of the Romanian petro-chemistry and its development, shouldn't be accidental and it should be improved.

The immense capital accumulations accomplished by the communist state, that permitted some great investments in the field of petro-chemistry, have been possible with the effort of the Romanian entire population. Therefore it is necessary to formulate some optimum privatization strategies of the petrochemical industry in a maximum transparence regime.

It is not the right place for a retroactive analysis regarding the privatization of this important industrial branch and the dramatic consequences of the change of the decision place and quality.

But, we have to mention the fact that no matter what political powers temporary lead Romania, we are all obliged to conceive in a responsible and optimum way the strategy regarding the development of the Romanian petro-chemistry, under the new historical conditions related to the integration of Romania in the European Union and the globalization process.

We consider that such an approach supposes the acceptance by all the actors, by mutual agreement, of some long-term policies, that are not limited to the duration of a political cycle. We don't have to "reinvent the wheel", we just have to accept that it is absolutely necessary to honestly adopt a national strategy that efficiently solves the problems specific to the historical evolution of the Romanian economy.

Under these circumstances, the judicious, informal, priority use of the Romanian specialists already trained, in the field of research-design-education who, by their experience may contribute to the formulation of some CD national strategies would be a necessity.

Therefore, we propose several thematic directions that should be included in the program of a national strategy:

– the elaboration of technical, economical and social viable solutions for the modern valorization of the industrial platforms, made for capital accumulations in the former regime (land, infrastructure, industrial units, technologies, human resources, etc.);

– the elaboration of proposals and studies on the optimum valorization of the natural resources of Romania, preventing the uncontrolled and dishonest externalization of the profits determined by such activities;

– the elaboration of solutions and studies regarding the development actions harmonization of some Romanian economical objectives with the development of the European Union markets, including the markets;

– the elaboration of researches, studies and projects regarding the diversification of the petrochemical production by supporting and encouraging the finding of technical solutions and investments by processing "deeper" the crude oil and natural gas as well as new power vectors;

– the particular development of some researches regarding the achievement of new equipments and unconventional energetic proceedings.

4.2.1. Petro-chemistry and the management public system of R-D activities

Without pleading for the return to the system in which the state played an exaggerated part in economy we have to say that the state powers (legislative, executive, judicial) have to be essentially responsible in relation to the reconstruction process of the Romanian economy, in which petro-chemistry continues to occupy a very important position.

As a result of the manifestation of some subjective mentalities with "historical" origins, the behavior of the decisive factors in relation to this important branch becomes really harmful for the Romanian society.

The Romanian government, by Decision no. 217 dated the 28th of February 2007 approved "The national strategy in the field of Research – Development – Innovation" for the period 2007-2013. Petro-chemistry is not explicitly considered a priority field as for example: Energetic, Agriculture and alimentary safety, Environment, Medicine a.o., they may not be separated from a complementary development of RDI in chemistry. With regard to Petro-chemistry no program or important activity are explicitly stipulated. In fact, we have to mention the fact that the lack of an explicit interest in this field is also reflected in the structure of the consultative bodies of the National Authority for Scientific Research in which petro-chemistry specialists are not included.

4.2.2. Proposals of measures regarding the Romanian petro-chemistry reconstruction

- The inclusion of petro-chemistry in the National strategy in the field of Research-Development-Innovation" for the period 2010-2013.
- The National Authority for Scientific Research and the Ministry of Economy to keep a record of the specialists in the field of research, design and production that have effectively took part in the achievement and exploitation of the main petrochemical platforms from Romania. These specialists could be included, as the case may be, in "Consultancy Colleges" for the Romanian state authorities in the process regarding the reforming of the Romanian industrial platforms. These Consultancy Colleges are going to assist the activities of the Romanian state in case of privatization, physical or judicial liquidation, reorientation, etc. The Colleges would assure a competent technical assistance under transparence circumstances and observance of the interests of the central and local bodies. The activity and competences of these Colleges should be settled by law. The Colleges should exercise their authority on all the petrochemical platforms whose infrastructure was achieved by the Romanian state, no matter who is the present owner.
- The introduction of a tax for the petroleum companies, no matter who is the owner, to supply a fund meant to achieve new geological prospecting and the financing of some research programs for the unconventional energetic.

- The adoption of a special law referring to "the liquidation or reorientation methodology of some petrochemical production capacities". Such a methodology would suppose the achievement of some feasibility studies analogous to those used at designing and achievement of some new production capacities and they should be achieved by certified and accredited engineering entities. These ones would contribute to the rational exploitation of the existing fixed funds and the limitation of the dishonest and irresponsible actions related to the transformation of some equipments and fabrication lines into scrap.
- The supporting by specific financial means (exemption from taxes, subventions a.o.) of RDI activities meant to the active valorization of some industrial units and the infrastructure of some partially or totally unused industrial platforms.
- The revision and elaboration of new norms and practices, more rigorous, for the units and industrial buildings assessors, used as liquidators. The introduction of the obligatory character of the achievement of some dismantling studies drawn up by certified and accredited engineering entities. The introduction of the severe legal sanctions for the dishonest actions that lead to the unjustified destruction of the petrochemical units.

4.3. In the field of legislation

Until 1995 the fundamental legislation regime in the petroleum field has remained the one existing before 1989. The first step regarding the improvement of the legislation in this field was made in 1995, when the Petroleum Law no. 134/1995 [8] was adopted, law that surprisingly preceded the occurrence of the Mines Law.

Mines Law no. 61/1998 [9], from which petroleum has been excluded, occurred only in March 1998, even if the gold, silver deposits and other mineral resources were at least as important as petroleum.

It is true that the petroleum Law no. 134/1995 repeals the previous petroleum law from 1942, but it is surprising that it does not repeal the specific legislation elaborated by the communist regime and included in the law regarding nationalization.

The petroleum law no. 238/2004 [11] does not differ much from Law no. 134/1995, basically, a completion of this one, with the provisions of the Governmental Emergency Ordinance no. 47/2002, regarding the modification and completion of the mining Law no. 61/1998.

Yet, there are some significant differences compared to the previous laws, as follow:

– even if in the mining law no. 61/1998 it is stipulated even from the preamble that "The investments in the mining field are encouraged by fiscal and administrative facilities, being free of any constraints regarding the recovery of the investments and the utilization of the accomplished profit", in the petroleum Law this paragraph is omitted, although the petrol itself is a mineral resource and is not at all less important compared to the other mineral resources mentioned in the mining Law;

– the duration of the exploitation license mentioned in the mining Law is 20 years with extension right for 5 year periods, while the present petroleum law is more prodigal and stipulates a 30 year period with possibility of extension up to 15 more years;

– in the mining Law it is stipulated that "the mining activities may be performed by the legal persons and also by the natural persons", while the present petroleum law entitles only the legal persons, restricting the right to the free competition of the natural persons;

– none of the versions of the petroleum Law occurred after 1990 does not refer to the essence of the domain, that is the petrol's capitalization degree.

Analyzing the previous petroleum laws as well as the one in force, we notice that the legislator took into account only the operations regarding prospecting, exploitation, deposits exploitations and petrol transportation not including in the law's provisions all the operations regarding petrol capitalization performed in the oil refineries and in petro-chemistry, as well as the activities essential to the evolution of the petroleum sector, that is those connected to research – development – designing.

The petroleum law seems to be taken out of the general context of the mining Law and moreover without any reference to natural gas, others than those associated to petrol.

Besides, studying other similar laws, belonging to countries with petroleum tradition, the petroleum Law occurs in these countries as a sub-division of the laws that concern the ensemble of the Mineral Resources Division, it refers to all the aspects connected to petrol including the operation safety measures and the measures for avoiding the contamination of the underground water layer, to those regarding the environmental protection: air, surface water and soil.

It is obvious that the decline of the basic petrochemical production in Romania compared to the level that it had in 1989 and especially compared to the productions presently accomplished by the other countries from Central Europe, was due to the lack of an appropriate strategic vision.

If in 1989 Romania was situated at the level of the present productions of some countries from Central Europe, for example Hungary, Poland, Czech Republic, between 1990 – 2009, Romania declined to the level of Serbia, without having any civil war and without NATO intervention, period within which the Petrochemical Complex from Pancevo and other industrial zones from Serbia were bombed.

If we also add to the above-presented things the fact that, in contradiction to Hungary, Poland and Czech Republic, Romania possesses however some petrol supplies, estimated to approximately 250 million tons and an annual production of approximately 4.5 million tons, supplies that do not exist neither in Pannonian Basin nor in Galitia, we will understand better the need for a national strategy in petro-chemistry reconstruction.

It also results that, even if Hungary, Poland and Czech Republic import the entire quantity of processed oil, especially from Russia, these countries understood

that beside the fuels production, they should also capitalize a part of the oil in petrochemical products for their own consumption and also for export, while Romania, even if it possesses its own oil production, transforms it mainly into fuels, most of which is exported, without highly capitalizing the oil into petrochemical products, that we highly import for internal consumption.

It results a double loss, from the selling of the fuels at export, instead of petrochemical products, and also a disequilibrium of the external payments balance by importing basic petrochemical products such as: polystyrene, polyethylene, polypropylene, synthetic rubber and carbon black for the factories manufacturing tyres, phenol, acetone, plasticizers and so long.

Even if in 2007, the estimated PIB of Romania was of 118.06 million euro, the current account deficit in the same year is of 16.87 million euro, that is about 14.29% of PIB and the deficit of the commercial payment balance sheet is of 17.58 million euro of which about 1.2 milliard euro represent the import of the basic petrochemical products. The deficit shows that about 17 milliard euro more have left than entered Romania, especially, due to the imports increase as for example the chemical and petrochemical products import.

The proposals regarding the modification proposed by us, are of sectorial type, as they refer to a well-delimitated field of activity – the petrochemistry, that is why the exact form and quantification of the grants referred to, will be determined within the consultations between the Ministry of Economy, acting as state grants supplier, and the Competition Council, that will have to give specialized advice, to certify a state draft project from the point of view of its accordance with the European legislation, project that will be sent at the European Commission in order to be authorized, in its capacity of Contact National Point in the field of state grants.

The approach regarding the getting of the required facilities should start from the business plans of the aimed and interested companies, able to develop petrochemical projects, companies that have to consult the Ministry of Economy in order to introduce the necessary sums in the budget of the following year. The discussion with the Ministry of Economy is essential because this one is the supplier of the state grant and it will have to draw up a draft project regarding the regional grants for investments, that will subsequently be notified to the European Commission in order to be authorized.

As a conclusion, the main objective of this proposal regarding the modification of the petroleum law is constituted by the state support of the investments that refer to the superior valorization of the petroleum in the petrochemical industry, by supporting, in accordance with the community legislation, the state grants.

5. THE INTEGRATION OF THE ROMANIAN PETROCHEMISTRY IN THE CENTRAL AND EASTERN EUROPEAN AREA

The main barometer that may characterize the level of the petro-chemistry industry of a country is represented by the ethylene production, that is the base of any chemical and petrochemical development.

First of all, in order to place the Western Europe within the general background of the ethylene producers, we present below the increase of the ethylene world capacity, from 100 million tons in 2000 to 130 million tons in 2008 and further on to 165 million tons in 2012 (figure 5.1 and figure 5.2).

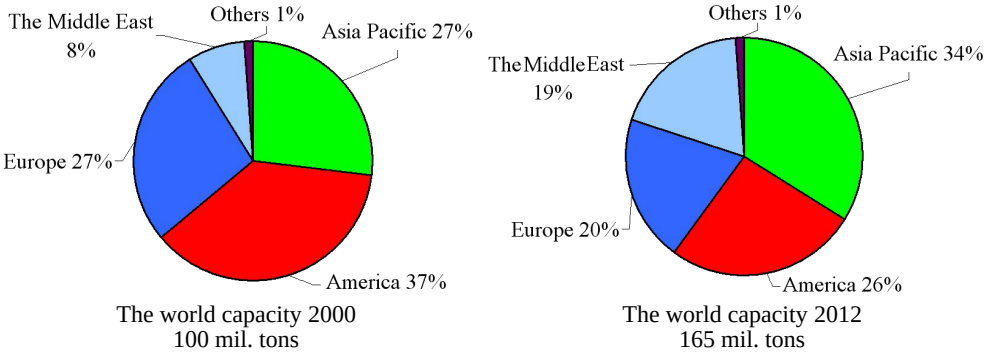


Fig. 5.1. The evolution of the ethylene world capacity until 2012.

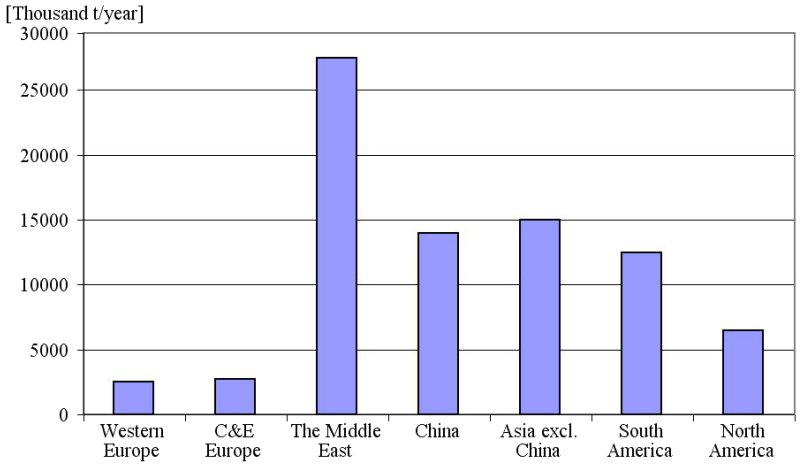


Fig. 5.2. The increase of the world capacity of ethylene production from 130 million tons in 2008 until 2020.

From figure 5.1 and figure 5.2 previously presented we easily remark the high development level of the ethylene production capacities in the world, the most important share being in the Middle East and Asia and also in the Western Europe and Central and Eastern Europe, that in 2012 will hold 20% of the ethylene world capacity (more than the Middle East, that will have 19%), behind Pacific Asia with 34% and America with 26%.

In Central and Eastern Europe the ethylene producers are presented in figure 5.3 and the comparison between them and the most important ethylene producers is presented in figure 5.4.

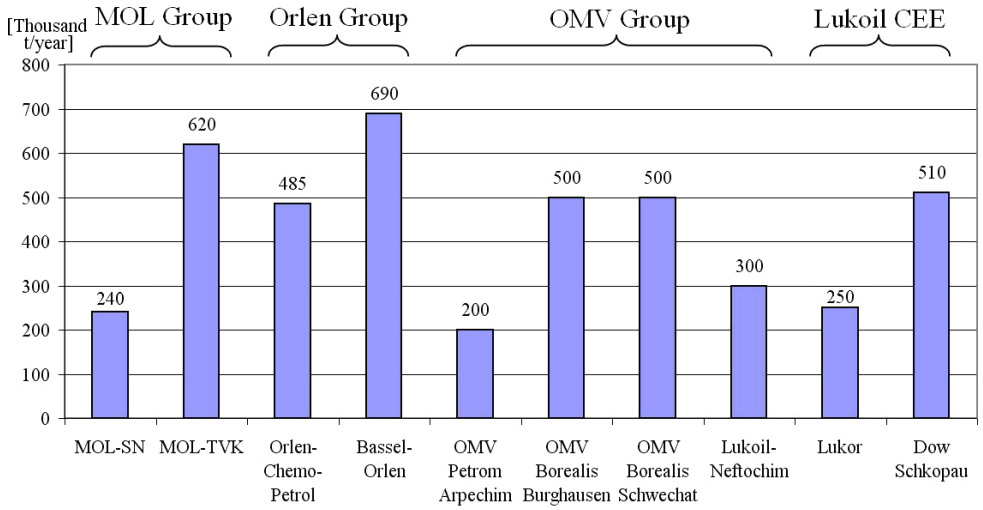


Fig. 5.3. The ethylene production in Central and Eastern Europe.

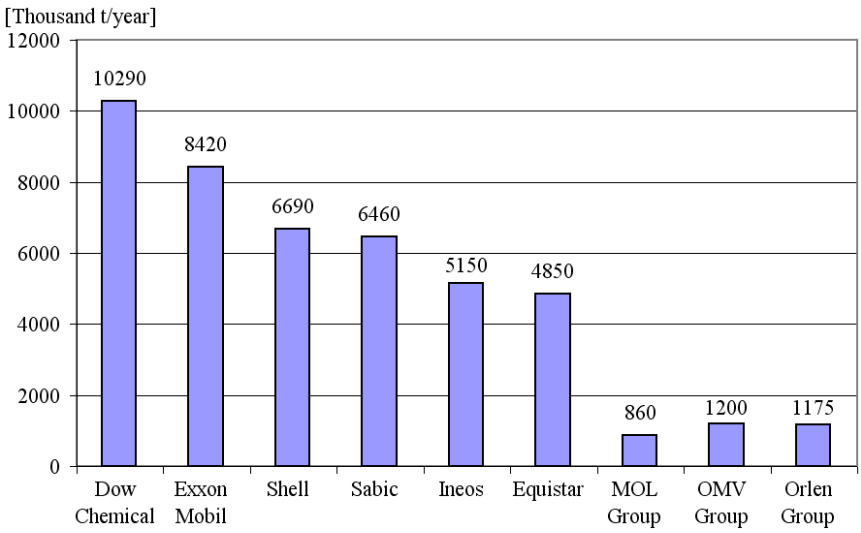


Fig. 5.4. The ethylene production in Central and Eastern Europe compared to the most important producers.

Compared to the world level (Dow Chemical, Exxon Mobil a.o.) the countries in the Central and Eastern Europe have at their disposal reduced capacities for ethylene production and OMV Petrom Group becomes even less important as long as the last Romanian pyrolysis unit has been shut down, Pyrolysis 2 unit from Arpechim Pitesti.

Oriented especially on the use of naphtha as feedstock, the ethylene production from Western Europe witnesses a development and modernization of the existent pyrolysis units and less the construction of new units.

Compared to the ethylene producers from the Persic Gulf that use especially ethane and propane as feed stocks, the European ones, even if they use more expensive liquid feed stocks, they succeed in having a profit due to the valuable collateral products simultaneously obtained from naphtha and Diesel oil pyrolysis: butan-butene cut, butadiene and aromatic hydrocarbons from the pyrolysis gas oil: benzene, toluene, o-, m- and p-xylene.

The great developments of the petro-chemistry in Central Europe are presented in the table 5.1, especially after 1990, period when Romania destroyed a performant petrochemical industry, existing before 1990.

Table 5.1

Petrochemical developments in Central Europe 2001-2006

Producer	Product	Capacity [Thousand tons/year]
MOL TVK	Ethylene	860
	Propylene	455
	LDPE	300
	HDPE	400
	Polypropylene	455
Orlen – Basell	Etylene	545
	Propylene	1200
	LDPE	700
	HDPE	180
	Polypropylene	400
OMV – Borealis	Etylene	640
	Propylene	1200
	LDPE	680
	HDPE	410
	Polypropylene	610

Before 1990 Romania had at its disposal important capacities of petrochemical products: 750,000 t/year ethylene, 400,000 t/year propylene, 214,000 t/year LDPE, 214,000 t/year LDPE, 120,000 t/year HDPE, 120,000 t/year polypropylene, 90,000 t/year polystyrene, all of them dismembered, being operational only the PVC production from Oltchim, based on VCM import.

The implementation of the reorganization measures proposed in this work could lead Romania to a production of 1.2 million tons per year after 2015: 0.3 mil. Petrochemicals Pitesti, 0.7 mil. tons – a new pyrolysis unit at Petrochemicals Pitesti and 0.2 mil. tons at Petromidia, if Rompetrol will decide the modernization and restarting of the pyrolysis unit from Petromidia.

In this alternative Romania could reach the present production level of OMV – Borealis, Orlen – Basell and to exceed the one accomplished by MOL – TVK.

The putting into practice of the development strategy proposed in this work will lead to the diminution of the present massive import of basic chemical and petrochemical products and after 2015 this will permit the integration of Romania in the Central and Eastern European area as a “market leader” in the PVC and polyolefines production.

6. INVESTMENT EFFORTS NECESSARY FOR THE RESTRUCTURING AND DEVELOPMENT

On development stages, the investment effort, estimated in a more precised way for the short and medium term investments, where more tenders have been taken into account, and with a higher degree of uncertainty for the long term investments (±35%), presents as follows:

6.1. The short-term reorganization – 2010

We estimate that in a short time Oltchim after the acquisition of the fixed means within the company Petrochemicals Arges, will perform the revision acquired units: Pyrolysis 2, HDPE, LDPE and EO/MEG, for which there is a memorandum by which the Romanian state guarantees the necessary bank loan, for the sum of 62 mil. euro.

6.2. The medium-term reorganization 2010 – 2012

The following investments are proposed for a medium term:

6.2.1. At Oltchim – Petrochemicals Arges

	Mil. Euro
– The modernization and capacity increase of the Pyrolysis 2 unit from 200,000 t/year to 300,000 t/year ethylene	116
– The replacement of the ethylene and propylene pipes between Oltchim and Petrochemicals Arges	20

6.2.2. At Oltchim – Ramnicu Valcea

	Mil. Euro
– New VMC unit 450,000 t/year	170
– The reconversion of the mercury electrolysis unit into membrane electrolysis	80
– Environmental protection	38
TOTAL 1 + 2	**486**

6.2.3. At Rafo Onesti

	Mil. Euro
– For the reconversion of the refinery for aromatic hydrocarbons production	450

6.2.4. At Petromidia

	Mil. Euro
– For the modernization of the pyrolysis unit at the same capacity of 200,000 t/year	340
MEDIUM-TERM TOTAL	**1,276**

6.3. The long-term reorganization – after 2012

	Mil. Euro
6.3.1. At Oltchim – Petrochemical Arges section	1,775
6.3.2. At Rafo Oneşti	570
LONG-TERM TOTAL	**2,345**

It is about a lot of money that may be attracted only by private companies associations that have a financial power and experience in the field of petrochemistry.

The short and medium-term stages have the advantage that they are covered by state guarantees, situation that makes the getting of bank credits easier, but this does not mean the getting of the loan, for which each company has to act insistently and with a lot of effort.

7. CONCLUSIONS

1) The research – development and production experience that Romania has at its disposal in the field of petroleum (150 years) and petro-chemistry (60 years), as well as the petroleum reserves that Romania still has, together with the available hydrocarbons on the world market, justify the relaunch of the Romanian petro-chemistry planned in the three stages mentioned in this work.

2) The crossing of the short-term stage as follows: the purchase by Oltchim of the company Petrochemicals Arges from OMV – Petrom and the restart of the Pyrolysis 2 unit is vital for the whole petro-chemistry development program.

The state institutions that may facilitate the getting of the loan from banks by Oltchim for the restarting of the technological units, have to act more firmly in relation to the Romanian banks in order to relieve the loan.

3) The development stage proposed for a medium-term Oltchim and Rafo Onesti are mostly facilitated by the two memoranda signed by the Ministry of Economy and the Romanian Prime Minister in order to get the necessary bank loans, on the basis of some state guarantees granted to the two companies.

4) The long-term development stage requires important sums of money therefore the interested companies have to give attention in advance to the elaboration of the development studies and the finding of the financing sources.

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In the past 20 years has always acted to restructure the chemical and petrochemical industrial production in Romania in the research and development of this important industry.

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