CURRENT CHALLANGES FACED BY PEMEX IN THE POLYETHYLENE INDUSTRY

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I. Market Situation.

The Mexican polyethylene market is estimated in 1.4 MMTY. Three different types of polyethylene dominate this market: high density (HDPE), linear low density (LLDPE) and low density polyethylene (LDPE). Table I shows the distribution by type of polyethylene in the market as well as the participation of Pemex Petroquimica (PPQ) in this market during 2008. PPQ is the only PE producer in Mexico.

Resin Type	Volume of the market (Participation)/MT (%)	PPQ production (Participation)/MT (%)
HDPE	562 (47)	119 (21)
LLDPE	291 (25)	78 (27)
LDPE	324 (28)	183 (56)

Table I. Mexican Polyethylene Market (Jan-Sep 2008)

As it can be seen, polyethylene requirements are higher than PPQ production. As a consequence, processors complete their needs with resins of others suppliers. Resins from Dow, EXXON, Equistar, Formosa and others can be found in Mexico. As it can be seen, the polyethylene market is not a monopoly, it is an open market and PPQ is one of the players.

The main applications of the resins are: HDPE: Injection, Blow molding, Film, Pipe; LLDPE and LDPE: Blow Film, Injection and Wire.

II. PPQ´s Strength, Weakness, Opportunities and Threats.

Table II shows the SWOT analysis for PPQ in the polyethylene market. As it can be seen, PPQ has experience in the polyethylene business and a good market position. Some of their principal weaknesses are low experience in International Markets, Technical Service and Innovation of the process. Nowadays, manufacturers require resins that can be used in high speed machines (productivity increase) and same (or better!) performance with less material (material reduction cost). PPQ competitors are world class companies with top technologies. PPQ requires more efficient production units, better resins and new technologies to keep competitiveness in the market.

PPQ SWOT Analysis

Strengths	Opportunities	Weakness	Threats
• Raw materials availability	• More efficient use of resources (e.g. energy)	• Low experience in International markets	• Increasingly competitive market (competitors, processing and new resins)
• Integrated production chains (from raw materials to costumers)	• Becoming a global blow film supplier (HDPE, LDPE, LLDPE)	• Investment	• New technologies and more efficient use of energy
• Experience in the polyethylene business	• Links with Universities and R&D Centers with expertise in polymer science	• Technical Service	• Integrated Companies
• Positioning and market acceptance		• Innovation of the process	• Competitors with own technologies
• Strong internal market and growing			• Competitors with high technological, geographical and marketing capacity of adaptation
• Geographic location			

Table II. PPQ SWOT Analysis.

III. Polyethylene Challenges.

PPQ has two production units for the production of HDPE: the Asahi and Mitsui Plant. Table III presents general information, strength, weakness, opportunities and challenges for both units. The Mitsui Plant was originally a PP unit which was converted into a PE plant in 2002. The resin produced in the Asahi plant is leader for production of 5 gallon pails. However, the technology of this unit is mature and the original licensor is no more in the business. So, the main challenges of these production units are: to explore new catalyst technologies, to develop reaction simulation process, to produce new grades of PE (HMW PE resins show better profits than other type of resins, use of different comonomers, new type of resins (e.g. chemically modified PE, nanocomposite materials)), new additives (for better performance). The strategy to follow is based on, first of all, developing commodity "plus" resins. The next step is to develop the new grades required for the Mexican market.

In the case of the LDPE Plant (Cangrejera), a new philosophy of operation is required based on fluid dynamics, advanced process control and rheological measurements. In addition, to analyze using new technologies in the production process such as the Tandem Technology is a point to consider. The comprehension of the runaway phenomena is matter of great importance for PPQ: an ethylene decomposition event in our plant means about a week of maintenance labor. With the aim of increasing the production slot of the Cangrejera Plant and to produce high value resins, one of the main challenges of this unit is to produce EVA or EBA copolymers. It´s also convenient to analyze the production of extrusion coating and low gel resins which are considered specialties in the LDPE business. Composite materials (included nano materials) can also be options for this plant as well as the production of films for agricultural applications. It is possible, that specialties such as EVA, EBA or composite materials could be developed in a smaller PPQ production unit of LDPE located in Poza Rica, Veracruz: the Escolin Petrochemical Complex (55 MTY capacity).

In the case of the Swing Plant, the main issue is the assimilation of the technology. The development of new grades such as Bimodal, Metallocenes, and PE 100 resins are available in the Univation technology. Maybe one issue here is to “adapt” or to obtain special LLDPE grades for the Mexican market. New sources of α-olefins (butane, hexane, octane) are critical for this plant.

The formation of specialized people in polymer science is another main challenge. Actually, 12 PPQ employees (Operations, Technical Service, Technical Department and Planning) are enrolled in a Master in Polymer Science program. The efforts must be extended to more people in order to create specialized teams for Production, Process, Technical Assistance and Laboratory.

Creation of specialized infrastructure for the characterization and applications of polymers is required. PPQ is planning to set a Technical Polymer Center in 2010. This Center will have 5 laboratories: Synthesis, Analytical, Physical Properties, Applications and Simulation. State of the art equipment and techniques will be enabled in this Center. The goal of this Center is to position PPQ in a favorable technological level.

As it can be concluded, PPQ´s challenges can be summarized in the following subjects: a) New Technologies (catalyst, additives, process), b) Simulation Process, c) Control Process, d) Better Performance Resins, e) Technological Assimilation; f) Qualified Human Resources; g) Specialized Infrastructure.
It’s clear that PPQ can’t do it alone. Links with R&D Centers (Private, Public) are required. Fortunately, Mexico has a high level in polymer science. The construction of a Polyethylene Network that includes R&D Centers, Universities and Industry (PPQ) can help PPQ in achieving its technological needs.

High Density Polyethylene			
Technical Info	**Strengths**	**Weakness**	**Challenges**
Mitsui Plant (slurry)			

• Technology: Mitsui
• Date of start up: 2002 (1990)
• Nominal capacity: 100 MTY
• Resins: Padmex 56035
• Markets: Blow molding, Pipe, Stretch film
	• Bimodal technology	• PP Plant converted to PE Plant
		  • Equipment
		  • Catalyst
		  • Grades
		• Blow molding: limited applications
			• New catalyst
			• Reaction Simulation Process
			• Development of new grades
			• On line control technology
			• New philosophy of Process Control
			• New additives
			• Nano composites materials
			• Copolymers
			• Development of modified PE

Asahi Plant (slurry)			

• Technology: Asahi
• Date of start up: 1989
• Nominal capacity: 100 MTY
• Resins: Padmex 65050, 65080
• Markets: Injection
	• Simple configuration
	  • One reactor
	  • Low catalyst cost
	  • Resin product leader
	  • pails (5 gallons))
		• Limited production grades
		• Mature Technology
		• Licensor no more in the business	

Table III. HDPE Strengths, Weakness and Challenges

LDPE Plant (Cangrejera)

Technical Info	Strengths	Weakness	Challenges

• Technology: ICI (High Pressure, Auto-clave)
• Date of start up: 2005 (1984)
• Nominal capacity: 315 MTY
• Resins: Padmex 20020 P, 20020 X, 22004
• Markets: Blow film
	• High production unit
	• Resins with good gloss properties
		• Mature Technology
		• Licensor no more in the business
			• New Production Technologies
			• New catalyst
			• Run away phenomena
			• Process Improvement
			• New grades
			  • Extrusion coating, EVA, EBA
			  • Low gel resins
			  • Composite materials
			  • Agricultural films

Table IV. LDPE Strengths, Weakness and Challenges

Linear Low and High Density Polyethylene

Technical Info	Strengths	Weakness	Challenges
Swing Plant (gas phase)			

• Technology: UNIVATION
• Date of start up: 2006
• Nominal capacity: 300 MTY
• Resins: PBDL 92010, PBDL 92020, Padmex 36050, Padmex 60120 U
• Markets: Blow film, Rotomolding, Injection molding
	• State of art technology
	• New production unit
		• Market already established
		• Assimilation process in progress
			• Complete assimilation
			  • Control Process
			  • Products
			• New grades
			  • Coating resins (MI=50 g/10 min)
			  • Metallocene resin
			  • PE100
			  • Bimodal resin
			  • Composite materials
			  • New additives
			• New sources of α-olefins

Table V. LLDPE Strengths, Weakness and Challenges