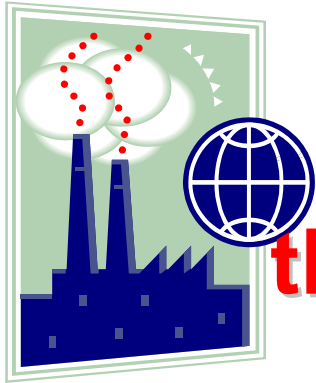

PET Manufacturing: Revolution by Evolution

By Delane Nagel Richardson

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GRUPPO MOSSI & GHISOLFI



A lot has happened
both for
the production companies
and
the engineering companies
in the field of PET
manufacturing.



The challenge for production companies has been to **increase capacity** and to consequently lower the manufacturing cost per unit of PET

The challenge for engineering companies has been to **lower the cost of capital** for new plants with higher capacities required


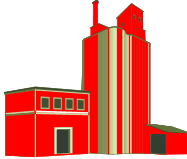




Capacity Evolution

Before M&G announced its Altamira plant in 2001, the largest capacities in the world were nominally 350 tonnes per day.

The more typical PET plant capacity was 240 tonnes per day.



Capacity Evolution.....what we knew!

| | <u>1997</u> | <u>1999</u> | <u>2003</u> |
|----------------------|--|---|--|
| <u>M&G</u> |  350 MT/day Italpet | |  1050 MT/day Altamira |
| <u>Industry Best</u> |  300 MT/day Celanese |  350 MT/day Dow Buna I | |
| <u>China Best</u> |  120 MT/day |  250 MT/day | |

Capacity Evolution: the “China Case”

Zimmer AG and Mitsubishi Chemtex used to dominate the Chinese market with plants in the range of 250 / 300 tonnes per day.

In the brief span of six years, China is now dominated by domestic technologies with 600 tonnes per day lines.



New Technologies: IntegRex and MTR



New technologies have been announced and installed to compete with the low overall cost of Chinese Plants.

In particular, Eastman IntegRex and Inventa MTR have abandoned the solid state polymerization process, producing a ***high viscosity chip straight from the melt***.

New Technologies: IntegRex and MTR

- ✓ **Both technologies produce an elliptical chip that is cut by a new underwater pelletization technique which simultaneously cuts and crystallizes the pellet making it suitable for injection molding without further treatment.**
 - ✓ **Both technologies propose a step change versus traditional technology, although IntegRex seems to be more radical than MTR.**
 - ✓ **Eastman has declared a proven capacity with IntegRex of 1,000 tons/day.**
 - ✓ **There is no news of any plant completely running MTR technology, but announced capacities, which will be on stream in 2009, are in the range of 600 tons/day.**
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M&G Approach

M&G has approached the problem with the insight of a **PET manufacturer** leveraging **30 years of injection and blow molding experience** gained in our own Italian plants.

Our philosophy has been to optimize commodity market driven

economies of scale

while maintaining

flexibility for our customers



M&G: Revolution by Evolution



Evolution

The acquisition of Chemtex International, Inc and a strict exclusive cooperation with Invist Performance Technology (IPT) has allowed M&G to push the rate of the melt phase to 1,400 t/d, which has been proven in our Suape (Brazil) plant.



Revolution

Rather than eliminating the solid state process, M&G has developed a completely new process called...

EasyUP™

M&G: Why Revolution



EasyUP™ technology allows solid stating in **very large incremental units** while providing better quality due to the very tight control of residence time distribution and the virtual absence of dust.

The **horizontal configuration of the reactor** substantially reduces the erection costs.


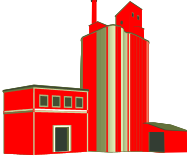
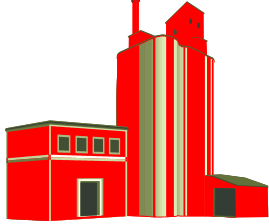








M&G: EasyUP™ Advantages



- ✓ **Customers seamlessly transitioned into existing applications**
 - ✓ **No limitations on EasyUP™ products suitability for any specific enduse**
 - ✓ **Maintains purification benefits of solid state process – no need for additives or special “aids”.**
 - ✓ **Optimized converters may benefit from fine tuned resin properties in applications needing tighter IV control, heat set or lower AA.**
-

Capacity Evolution ... Today!

M&G Superior PET Engineering

| | <u>1997</u> | <u>1999</u> | <u>2003</u> | <u>2005</u> | <u>2007</u> |
|----------------------|--|--|--|---|--|
| <u>M&G</u> |  350 MT/day Italpet | |  1050 MT/day Altamira | |  1500 MT/day Suape |
| <u>Industry Best</u> |  300 MT/day Celanese |  350 MT/day Dow Buna I | |  450 MT/day Dow Buna II |  1000 MT/day Eastman US (Integrex) |
| <u>China Best</u> |  120 MT/day |  250 MT/day | |  400 MT/day |  600 MT/day |

M&G: Why Evolution

The in depth knowledge of the line and process has allowed us to open new frontiers in capacity scale-up.

On July 25, 2007 M&G announced its **new NAFTA plant at 2300 t/d or 800 kt/y** and we see no limitations to further scale-ups.

The plant will be built using proprietary reactor designs, but with the same technology proven in Altamira and Suape.

The announced capacity is twice the size of the only other “mega” plant built by our competitors and 4 times the average large line capacity.

M&G: Why Revolution

As an industry leader, M&G recognizes the need to provide materials with enhanced performance such as barrier, but maintaining a conventional pellet form.

With this approach, the customers can benefit from specialty products without being forced to modify their process to run a new resin.

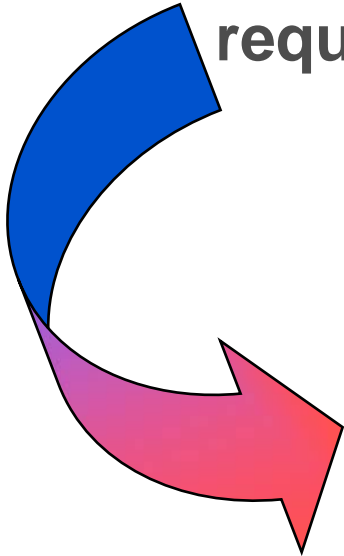
“Simple” is revolution!

All M&G's jumbo lines are suitable to produce specialty products through the new

BiCo™ technology

BiCo™ carries

in the core of the pellet all the modifying agents
required for the specific application.



“Simple”



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With BiCo™, M&G can produce
a specialty product
**without compromising economies of
scale.**

The lines produce a base product which is
modified at the end of the line with the inclusion
of the additive in the core of the pellet.

The amorphous chip is then solid stated with
the new *EasyUP™* technology.

M&G Bico™ products are posing
no problems to customers:

- 😊 No additive
- 😊 No special feeding
- 😊 No differential in drying
- 😊 No problems in product handling

Conclusions



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- **Technology is important to maintain cost competitiveness in the development of new markets**
 - **With rationalization, producer technology becomes a key winning factor for the PET industry**
 - **Fewer PET producers will be able to afford to incorporate technology as part of their offering**
 - **M&G is the largest PET producer in overall size and in terms of technology effort**
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