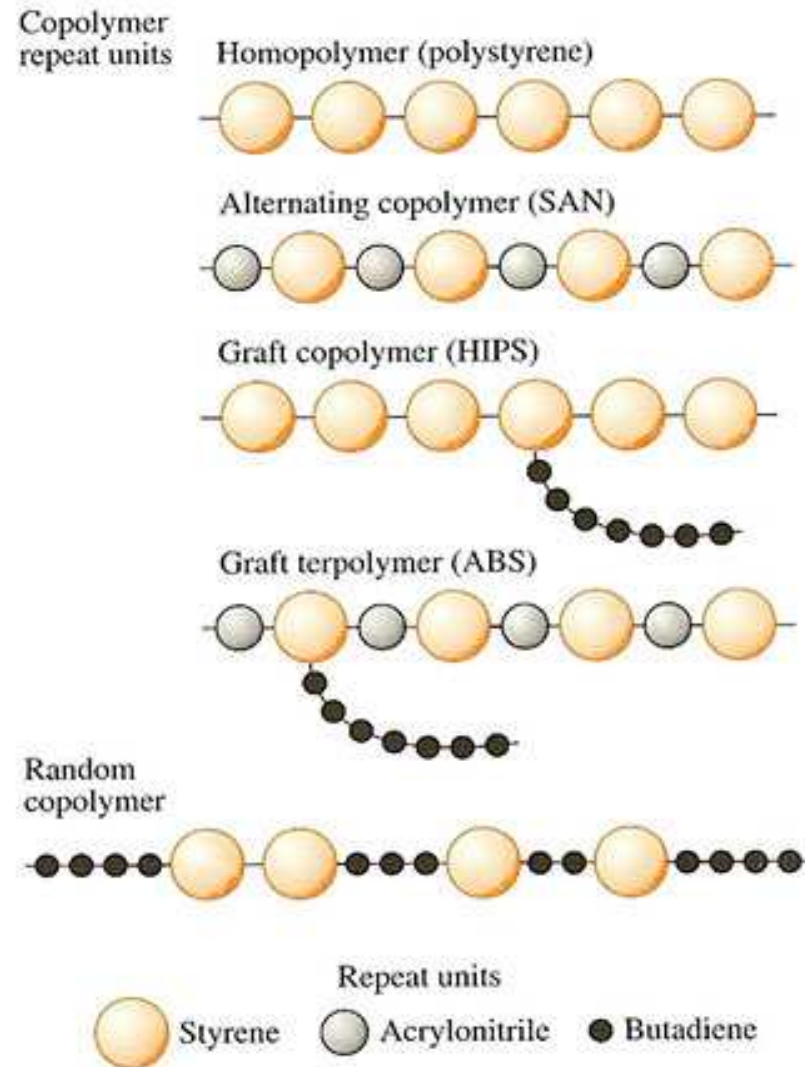


# Estruturas de polímeros

Termoplásticos, termofixos e  
elastômeros

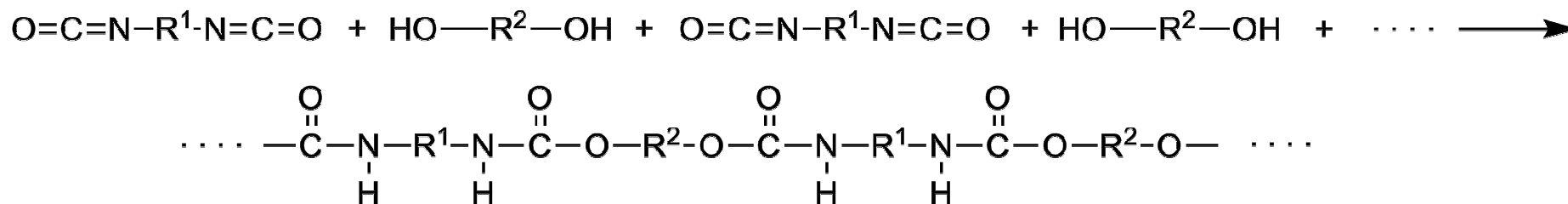
- Há muitas maneiras de montar cadeias.
- Cadeias diferentes geram produtos com propriedades diferentes.

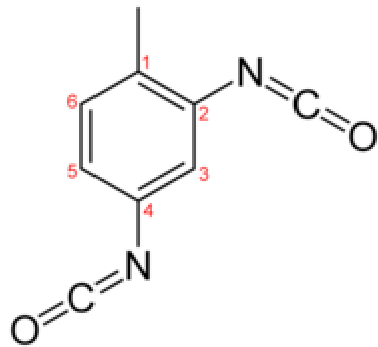
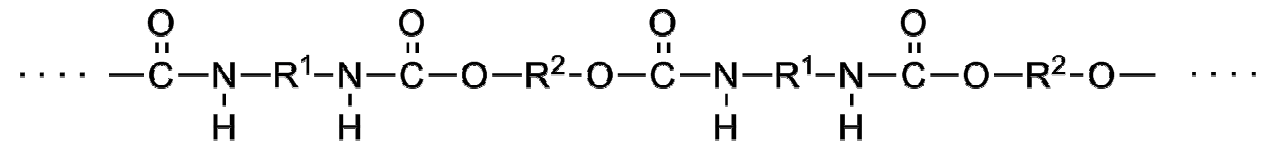
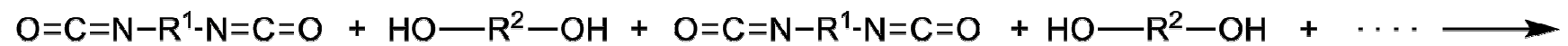


# Monômeros formando blocos, ou alternados, ou ao acaso

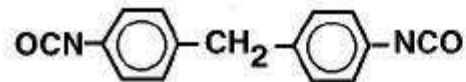


- Copolímeros-bloco: um bloco flexível, outro rígido: que propriedades tem o polímero?

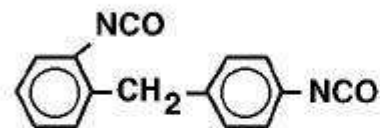




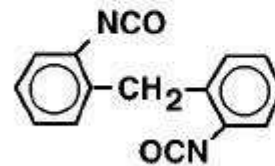
4,4'



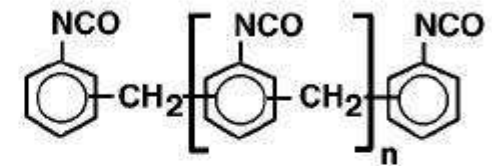
2,4'



2,2'



Pure MDI's



Polymeric MDI's

# Grande diversidade de produtos

GLS - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.gls2/product\_results.jsp?action=listAll

Getting Started Latest Headlines Gmail Estado Dicionários http://www.ituniv.se...

Overview  
 DYNaflex®  
 VERSAfex®  
 VERSalloy®  
 VERSollan®  
 KRATON®

Product Search  
 Custom TPEs  
 New Products

Related  
[Case Studies](#)  
[Ask Our Engineers](#)

## Search Results

Materials that match your search criteria: 87 / 87 null

Product Family	Grade	Hardness	Color	Bonds To	Specific Gravity	Ultimate Tensile*	100% Modulus*	Ultimate Elongation*	Tear Strength*	NSF	FDA	UL	Usp VI
Dynaflex®	<a href="#">D3202-1000-03</a>	59 A	Nat	PS, HIPS	0.99	700	670	230	140				
Dynaflex®	<a href="#">D3204-1000-03</a>	82 A	Nat	PS, HIPS	1.01	1240	990	400	260				
Dynaflex®	<a href="#">D3226-1000-03</a>	40 A	Nat	PS, HIPS	0.99	580	430	270	90				
Dynaflex®	<a href="#">G2701-1000-02</a>	66 A	Trans	PP	0.90	1050	490	590	240	Yes			
Dynaflex®	<a href="#">G2703-1000-00</a>	58 A	Trans	PP	0.90	1160	310	690	180	Yes			
Dynaflex®	<a href="#">G2706-1000-00</a>	28 A	Trans	PP	0.89	1010	90	710	80	Yes			Yes
Dynaflex®	<a href="#">G2709-1000-00</a>	53 A	Trans	PP	0.89	980	240	670	140	Yes			
Dynaflex®	<a href="#">G2711-1000-00</a>	43 A	Trans	PP	0.89	830	180	650	130	Yes			Yes
Dynaflex®	<a href="#">G2712-1000-02</a>	43 A	Trans	PP	0.89	820	190	700	110	Yes			
Dynaflex®	<a href="#">G2755-1000-00</a>	55 A	Trans	PP	0.88	770	220	700	120	Yes			
Dynaflex®	<a href="#">G2780-0001</a>	84 A	Trans	PP PE	0.90	1200	840	370	250	Yes			
Dynaflex®	<a href="#">G6703-0001</a>	3 A	Trans	PP	0.90	390	20	1030	40				
Dynaflex®	<a href="#">G6713-0001</a>	13 A	Trans	PP	0.88	200	57	540	40	Yes			
Dynaflex®	<a href="#">G6730</a>	30 A	Trans	PP	0.91	740	110	530	80				
Dynaflex®	<a href="#">G7410-1000-00</a>	64 A	Nat	PP	0.91	700	390	420	160				
Dynaflex®	<a href="#">G7431-1001-00</a>	66 A	Nat	PP	0.92	1330	390	610	200				
Dynaflex®	<a href="#">G7702-9001-02</a>	37 A	Black	PP	1.10	600	140	480	120				
Dynaflex®	<a href="#">G7736-1</a>	37 A	Nat	PP	1.06	430	150	600	80	Yes			
Dynaflex®	<a href="#">G7930-1001-00</a>	30 A	Nat	PP	1.06	490	130	650	100	51	Yes	HB	
Dynaflex®	<a href="#">G7930-9001-02</a>	30 A	Black	PP	1.06	400	100	640	90	51	Yes	HB	
Dynaflex®	<a href="#">G7940-1001-00</a>	40 A	Nat	PP	1.18	450	180	450	100	51	Yes	HB	
Dynaflex®	<a href="#">G7940-9001-02</a>	40 A	Black	PP	1.18	510	190	450	100	51	Yes	HB	

Done

start Calendar - Mi... Agenda2008... Sites.doc - M... Prova.doc - ... Microsoft Po... GLS - Mozilla ... 6:30 AM

## Search Results

Materials that match your search criteria: 87 /87 null

Product Family	Grade	Hardness	Color	Bonds To	Specific Gravity	Ultimate Tensile*	100% Modulus*	Ultimate Elongation*	Tear Strength*	NSF	FDA	UL	USP VI
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Dynaflex®	<a href="#">G2706-1000-00</a>	28 A	Trans	PP	0.89	1010	90	710	80	Yes		Yes	
Dynaflex®	<a href="#">G2709-1000-00</a>	53 A	Trans	PP	0.89	980	240	670	140	Yes			
Dynaflex®	<a href="#">G2711-1000-00</a>	43 A	Trans	PP	0.89	830	180	650	130	Yes		Yes	
Dynaflex®	<a href="#">G2712-1000-02</a>	43 A	Trans	PP	0.89	820	190	700	110	Yes			
Dynaflex®	<a href="#">G2755-1000-00</a>	55 A	Trans	PP	0.88	770	220	700	120	Yes			
Dynaflex®	<a href="#">G2780-0001</a>	84 A	Trans	PP PE	0.90	1200	840	370	250	Yes			
Dynaflex®	<a href="#">G6703-0001</a>	3 A	Trans	PP	0.90	390	20	1030	40				
Dynaflex®	<a href="#">G6713-0001</a>	13 A	Trans	PP	0.88	200	57	540	40	Yes			
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Dynaflex®	<a href="#">G7431-1001-00</a>	66 A	Nat	PP	0.92	1330	390	610	200				
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Dynaflex®	<a href="#">G7940-9001-02</a>	40 A	Black	PP	1.18	510	190	450	100	51	Yes	HB	

- **Dow to expand European SSBR**

***June 11, 2007*** Dow Chemical has started building a 60,000 tonnes solution styrene butadiene rubber plant at Schkopau in Germany. It already has SSBR and PBR plants in Germany and France and is back-integrated into butadiene and styrene. Off-take from the new plant will be aimed at the tyre sector.

Dow says SSBR is the fastest growing segment of the rubber market with an anticipated annual growth rate of 5 - 6 per cent over the next few years.

The new facility will include a capacity rights agreement with JSR Corporation of Japan.

- <http://www.polymer-age.co.uk/news.htm>

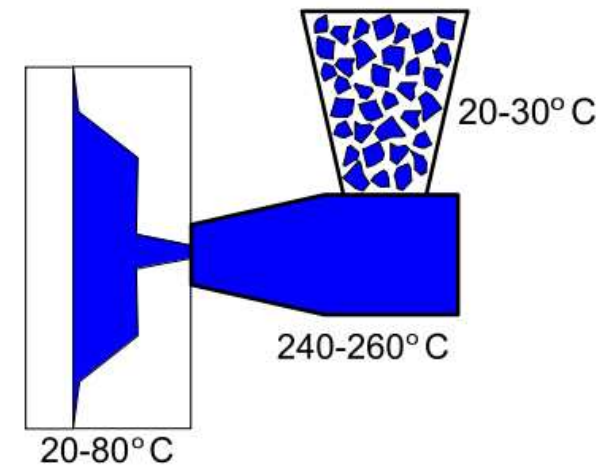
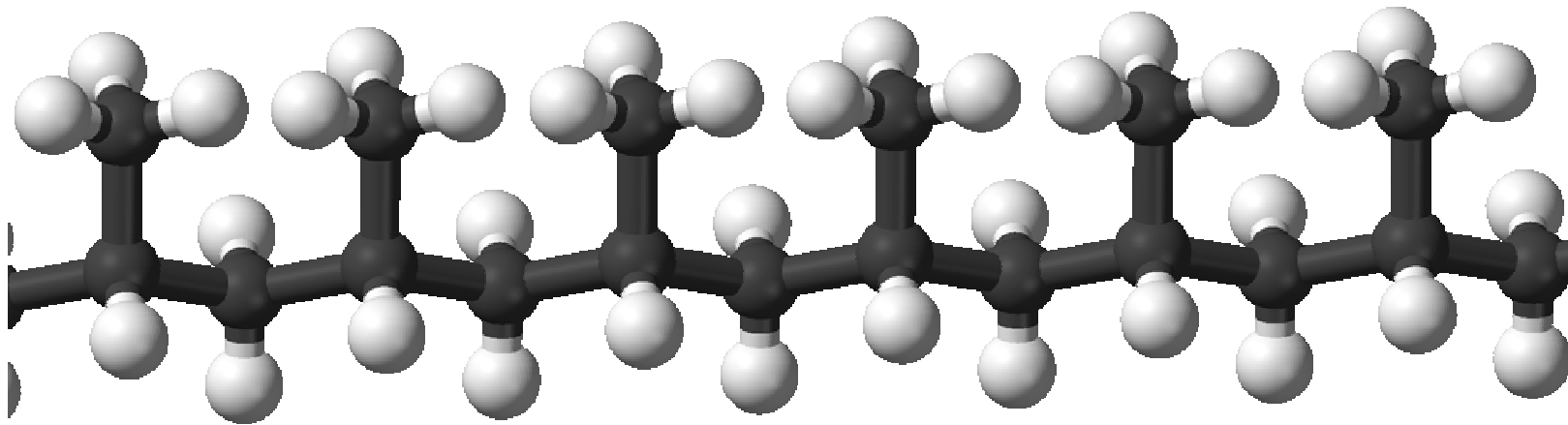
# Características das cadeias

- Isomeria
  - Taticidade: iso-, sindio-, a-
  - Cis/trans
- Flexíveis ou rígidas
  - Monômero
  - Temperatura
  - Plastificantes
- Independentes ou conectadas
  - Entrelaçamento
  - Reticulação (vulcanização)
  - Separação de fases
  - Cristalização parcial

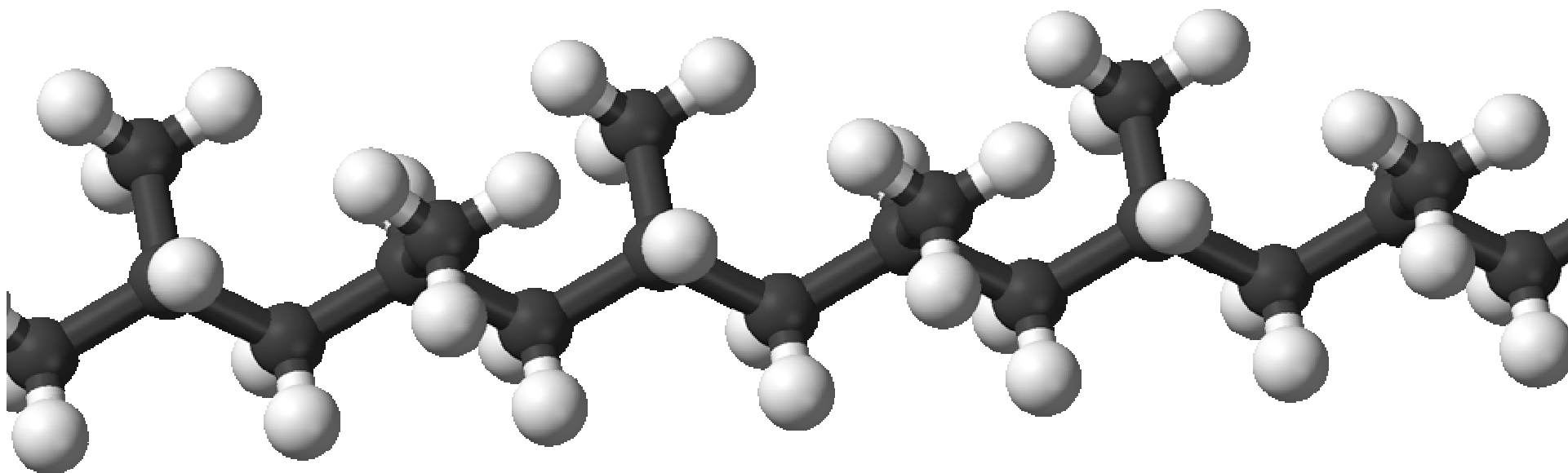


# Polipropileno isotático

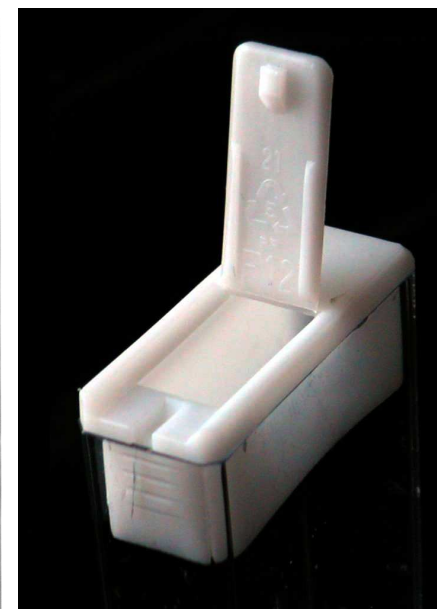
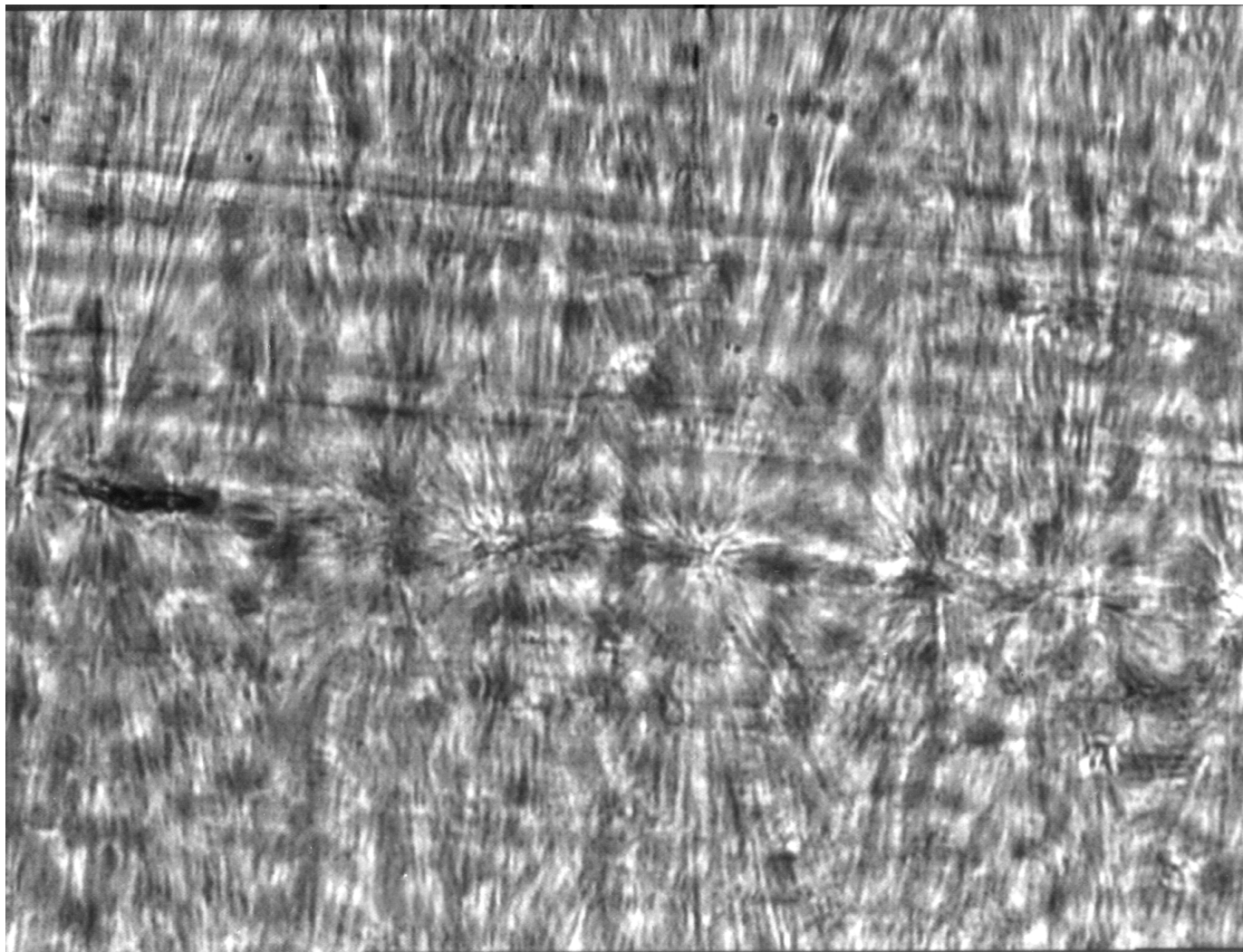
- <http://commons.wikimedia.org/wiki/Image:Isotactic-polypropylene-plan-3D-balls.png>



# Polipropileno sindiotático

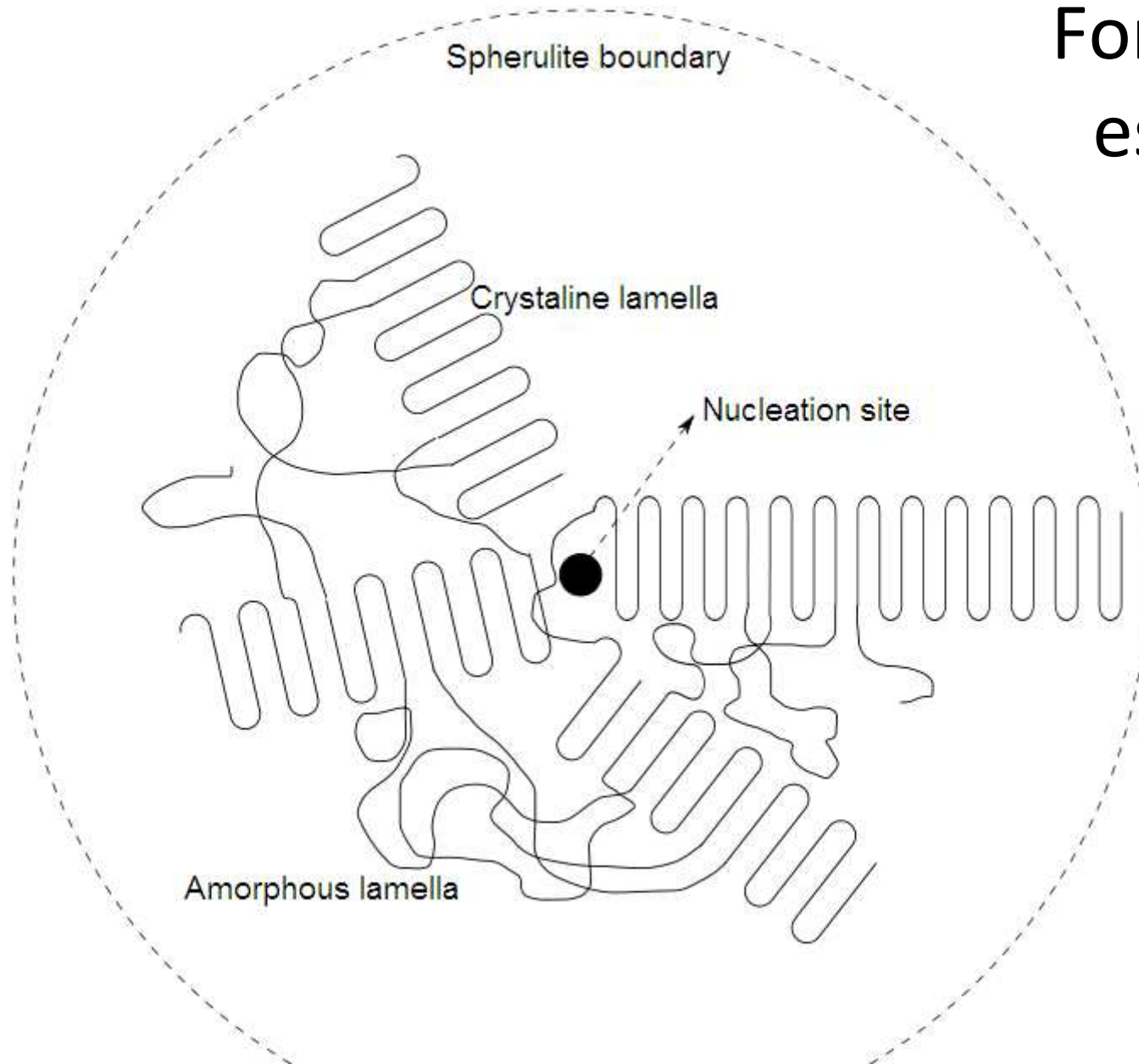


Polipropileno cristaliza: micrografia ótica em microscópio de luz polarizada. Polímero semicristalino, esferulitos.



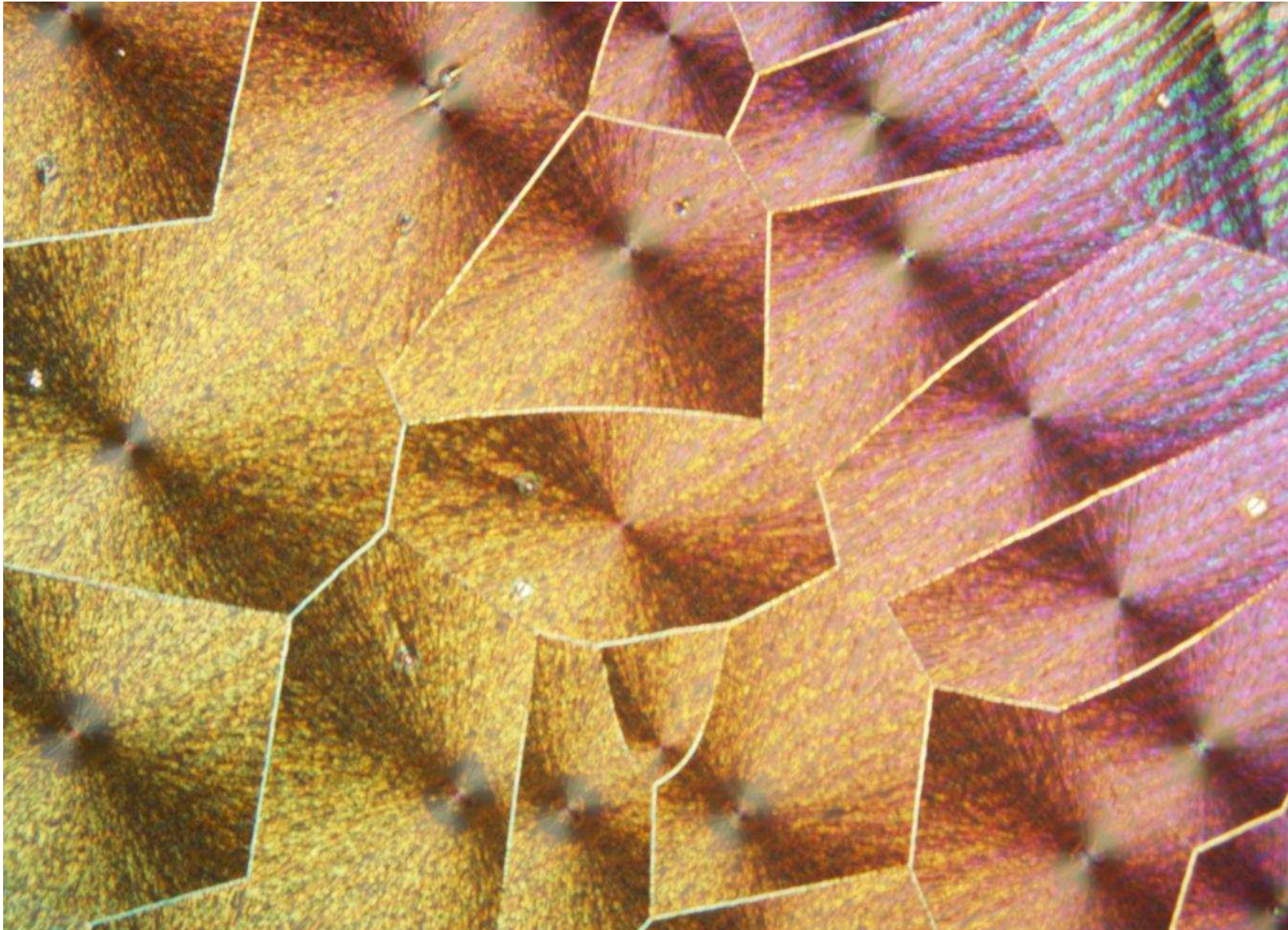
[http://en.wikipedia.org/wiki/Image:Polypropene\\_migrograph.png](http://en.wikipedia.org/wiki/Image:Polypropene_migrograph.png)

# Formação de esferulitos





## PEO no microscópio de luz polarizada



# Grande vantagem: custos previsíveis

## CostMate® - Injection molding part cost estimator.

### General

Part Name/Description

Quantity (1,000's)

Profit  %

Based Upon ☒ Total Quote Price ☐ Actual Costs

Include Material Cost in Profit? ☒

### Material

Material Price  \$/lb

Part Volume  in<sup>3</sup>

Sprue/Runner Volume  in<sup>3</sup>

Specific Gravity

Max Allow Regrind  %

### Machine

Setup Costs \$  /quote

Cost to Run \$  /hr

Labor Operator Cost \$  /hr

Number of Cavities

Downtime  %

### Processing

Cycle Time  sec

Reject Rate (Available for Regrind)  %

Scrap (Not Available for Regrind)  %

### Miscellaneous Costs

Secondary Costs \$  /quote

Display Results As ☒ English ☐ SI

### Step 1:

General Information

Enter general part information, the quantity (in 1000's) to be produced and the profit. The currency unit is shown as US dollars (\$), but CostMate® will estimate your quote correctly with any currency.

### Step 2:

Material Information

Enter the material parameters and the estimated part and sprue/runner volume. Remember, the sprue/runner volume will affect the overall material volume.

### Step 3:

Machine Information

Enter the machine cost of operation, estimated downtime and the number of mold cavities.

### Step 4:

Processing Information

Enter the cycle time, the regrindable material available and the scrap. The regrind material comes from two sources: parts and sprue/runner system.

### Step 5:

Secondary Cost Information

Enter any additional costs to complete the entire job.

### Step 6:

Calculate the Quote

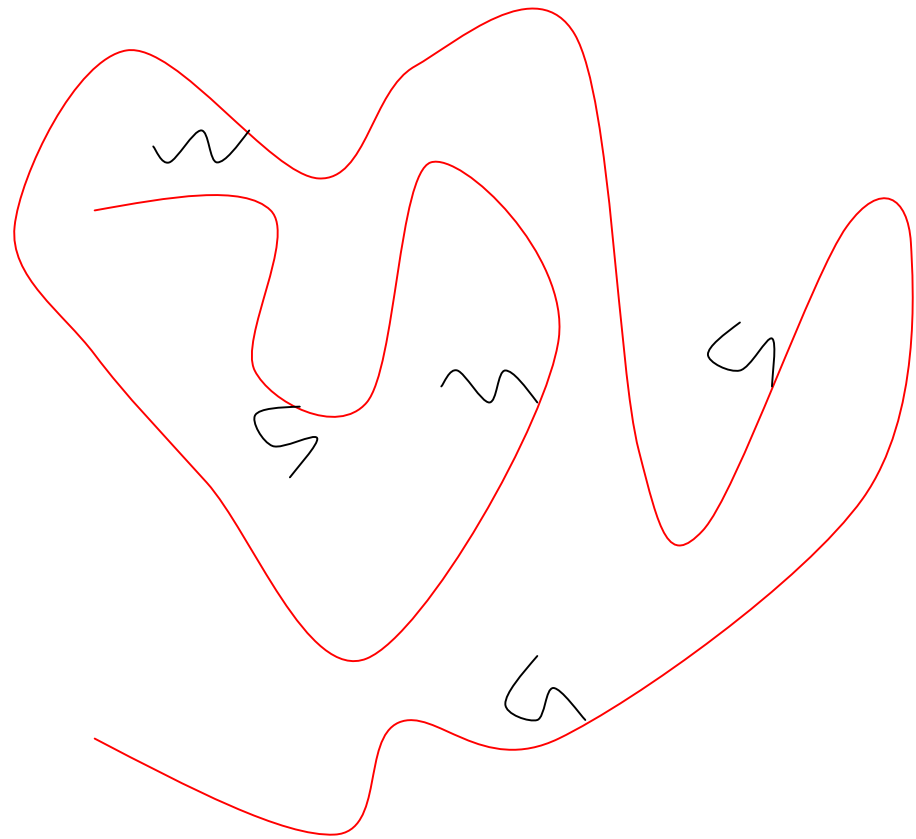
Calculate the Quote. Your CostMate® quote inputs will be remembered so the next time you use CostMate® this quote will appear.

**CostMate® Quote =** Material Costs + Machine Costs + Secondary Costs + Profit

<http://www.ides.com/costmate/>

# Enxertia

- Anidrido maleico em polipropileno
- Ácido acrílico em teflon
- Cadeias polares ligadas a cadeias apolares





# Enxertia de MMA em borracha natural



*Manufacturers of Custom  
Natural & Synthetic Latex Compounds,  
Adhesives & Rubber Chemical Emulsions*

Sunday March 25th 2007

## Heveatex Graft Polymer Products

**Heveatex Graft Polymers** are a unique series of products for the rubber industry. They are produced by grafting methyl methacrylate onto natural rubber latex. As such, they will exhibit a combination of elastomeric and plastic properties.

These products will yield strong adhesion between such dissimilar materials as natural and synthetic rubber, leather, polyvinyl chloride, textiles, and metals. Conventional pressure-sensitive natural rubber compounds can be tie-bonded to various plastic bases, particularly polyvinyl chloride and polypropylene. If the vinyl pyridine used in tire cord adhesives is replaced with graft polymer latex, superior adhesion can be obtained.

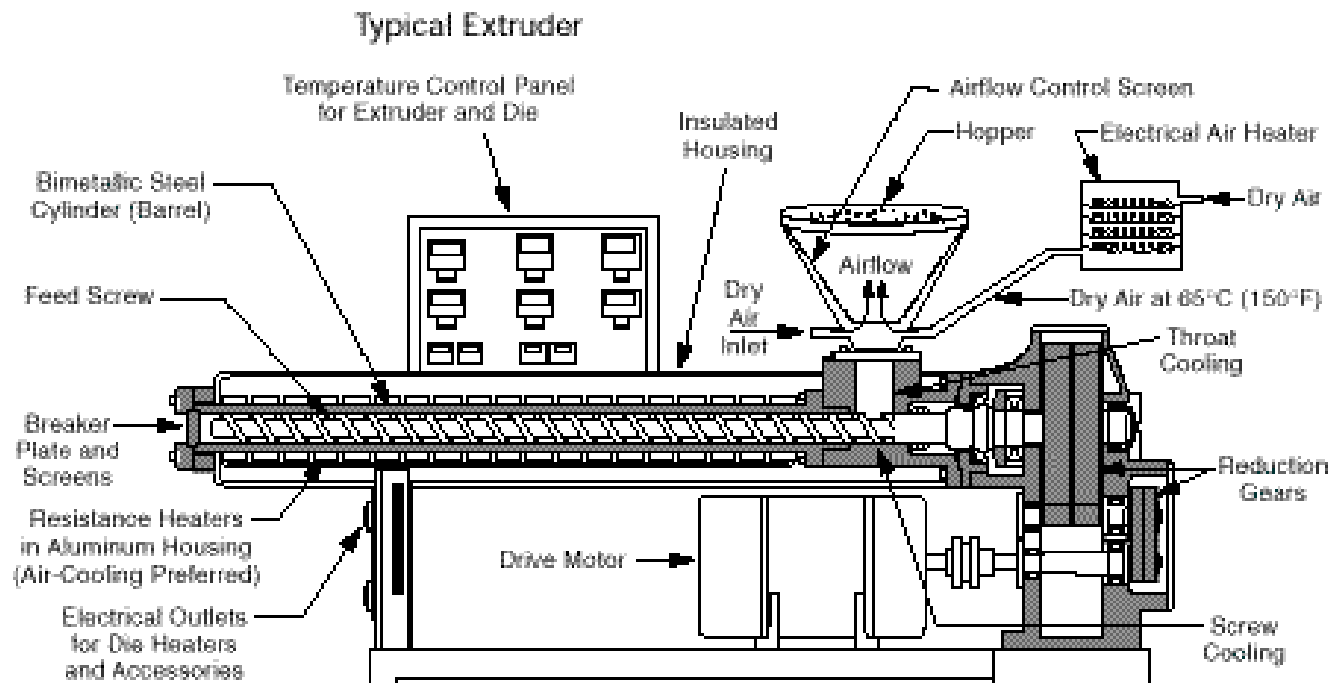
Three graft polymer latices are currently available. They differ only in rubber to methyl methacrylate ratio. They are compatible with a wide variety of emulsion polymers and latices. When compounding graft polymer latices, allowances should be made for calculating curative ingredient levels. A solid version is also available which can be made into solvent-based adhesives/primers.

Typical Properties				
Product Code	001320	001330	1330/40	08000
Physical Form	Latex	Latex	Latex	Milled Crepe
NR/MMA Ratio	80/20	70/30	70/30	50/50
Total Solids (%)	58.5	50	40	N/A
PH	10.5	10.5	10.5	N/A
Wt/Gallon (lbs)	8.10	8.30	8.20	N/A
Ingredients of the above are acceptable under 29 CFR as follows:				
Part 175.105	Yes	Yes	Yes	Yes
Part 175.300	No	Yes	Yes	No

Heveatex Corporation  
A Tillotson Company  
63 Water Street,  
P.O. Box 2760  
Fall River, MA 02721  
Tel: 508.675.0181 or  
Toll Free: 800.922.0078  
Fax: 508.677.0370  
www.heveatex.com



# Processamento reativo



- Os reagentes são injetados na massa de polímero fundido, em uma extrusora.
- Vantagens: excelente capacidade de mistura, controle de temperatura ótimo.

# Enxertia iniciada por chama (flambagem)

Inventores: S. Lee, R. Rengarajan

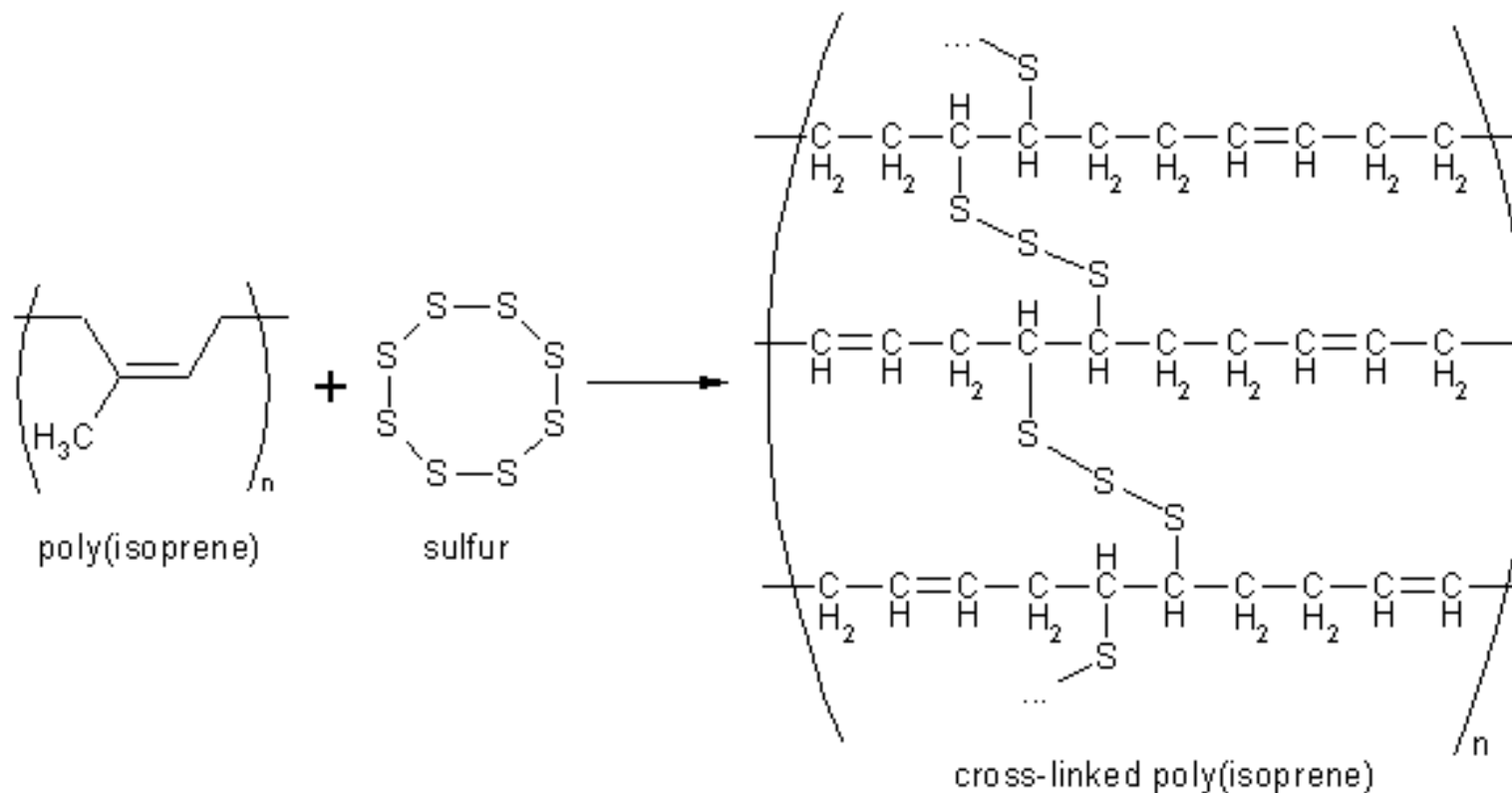
- U.S. Patent 5,571,869
- Polímero sólido é flambado (sua superfície é exposta a uma chama resultante da ignição de um gás com ar ou oxigênio, para produzir radicais livres).
- Monômeros vinílicos são postos em contacto com a superfície ativada pela chama, formando-se enxerto.
- Reação em fase sólida, em batelada ou contínua, não precisa de peróxidos, solventes ou radiação.
- Pode ser usada com PE, HDPE, PP, PS, PVC, PAN, PC, PI, PVAC, PVA, PU, polidienos, poliésteres.
- Vantagens
  - 1) eficiência energética (baixas temperaturas e pressões)
  - 2) não usa solventes nem reagentes ambientalmente problemáticos

# Derivatização: celulose e amido

- Características
  - Hidroxilas reativas
  - Cristalinidade
- Derivados
  - Carboximetilcelulose (ácido cloroacético)
  - Metilcelulose (cloreto de metila)
  - Hidroxietilcelulose (cloroetanol)
  - Acetatos de celulose (anidrido acético)

# Reticulação

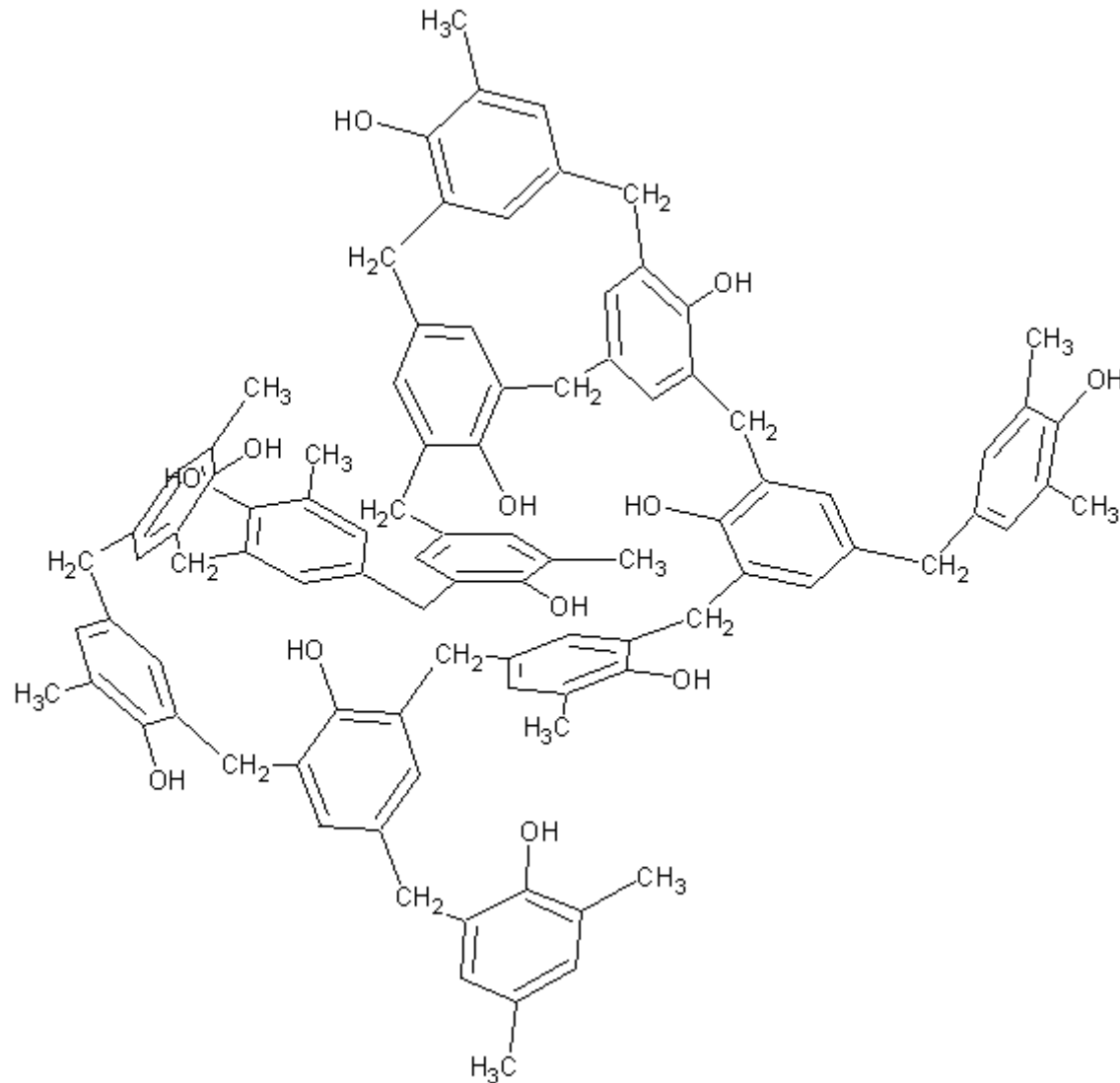
- Vulcanização de borracha natural
- Descoberta por Goodyear



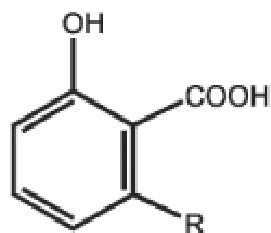
# Reticulação de polietileno

- Peróxido (Engel). Reticulação a quente, acima do ponto de fusão.
  - Ligação entre átomos de carbono.
  - Usa peróxido de di-isocumila.
  - Produto uniforme, bom controle do processo.
  - Reação demorada, consome tempo de extrusora.
- Método de silano, ou “úmido”.
  - Primeiro, se enxerta um vinilsilano no PE.
  - Cura é feita por condensação de grupos silanol.
  - Pontes C-C-Si-O-Si-C-C entre as cadeias.
- Processamento por feixe de elétrons
  - Feito a frio (abaixo da temperatura de fusão)
  - Produto pode ser desuniforme, mais reticulado no exterior que no interior.
  - Método limpo, não usa outros reagentes nem gera resíduos.

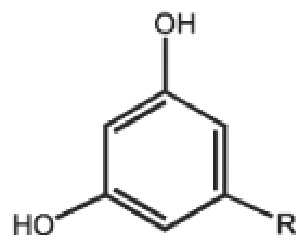
# Fenol-formol



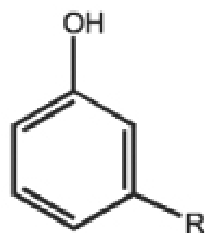
- Em meio ácido: polímero linear (novolac)
- Em meio alcalino: reticulação



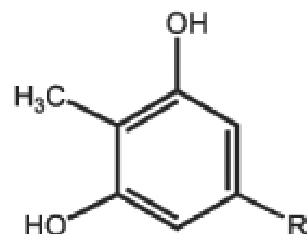
Anacardic Acid



Cardol



Cardanol




2-Methyl cardol




n = 0		3%
n = 1		34-36%
n = 2		21-22%
n = 3		40-41%

# Alternativas ao fenol


**Subraya** *Clean Crisp Cashew Nuts*  
 ISO 22000:2005 CERTIFIED COMPANY

[Home](#)
[About Us](#)
[Products](#)
[Plant & Process](#)
[Information](#)
[Contact Us](#)





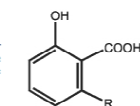
**Cardanol**

## Cardanol

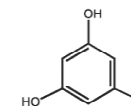
Commercial CNSL Under reduced Pressure was distilled at a temperature of 225o C under reduced pressure (1mm of Hg) to obtain cardanol. A pale yellow to brown liquid of refractive index 1.5 at 30o C .Cardanol is a phenol which has a C15 unsaturated alkyl chain with 1-3 double bonds at m-position.Cardanol is a mixture of cardanol 90% and cardol 10%.

## Specifications of Cardanol

Properties	Grade-I	Grade-II
Appearance	Yellowish	Yellowish
Refractive Index	1.500-1.510	1.500-1.510
Viscosity	1.5-2.0	1.5-2.0
Flash Point	110-120	110-120
Boiling Point	225-235	225-235
Freezing Point	-10 to -15	-10 to -15
Water Solubility	Insoluble	Insoluble
Acid Value	0.5-1.0	0.5-1.0
Saponification Value	10-15	10-15
Peroxide Value	0.5-1.0	0.5-1.0
Unsaturation	1.5-2.0	1.5-2.0
Stability	Stable	Stable



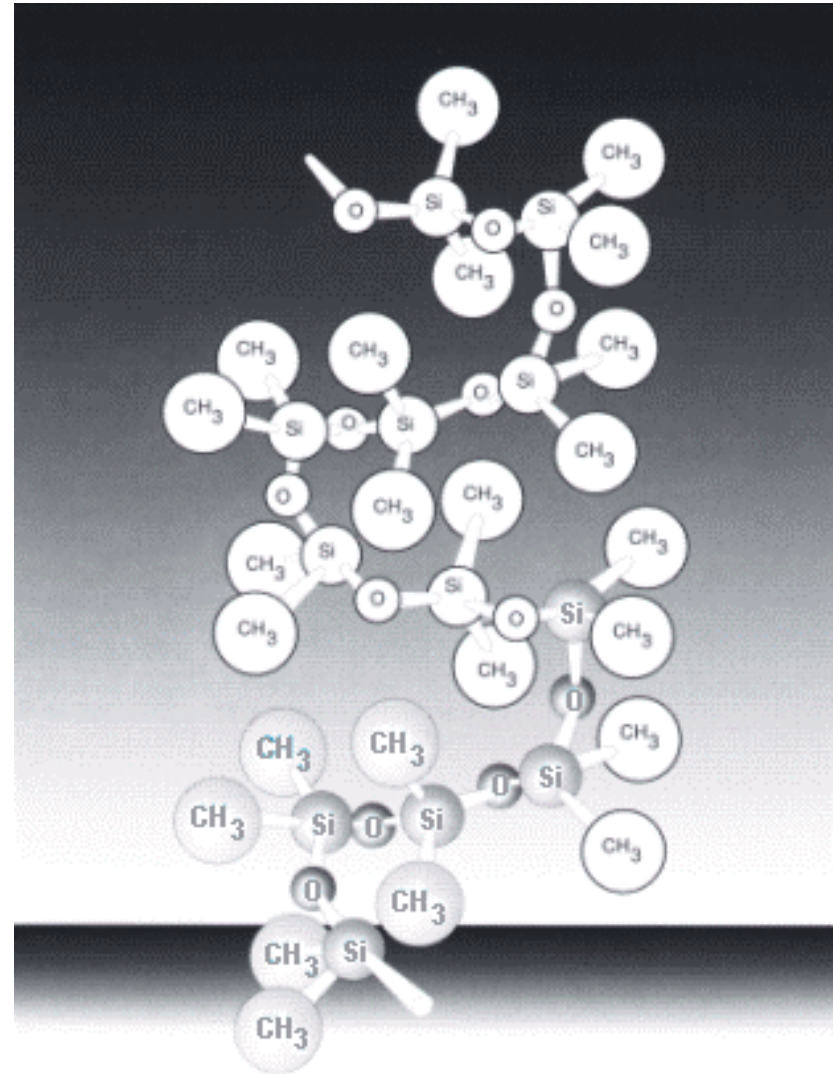
Anacardic Acid



Cardol

# Equilíbrio de polimerização

- Siliconas
- Polímeros e oligômeros cíclicos e lineares
- Oligômeros podem ser destilados de PDMS
- Reações de “cura” (healing):  
recomposição de defeitos mecânicos





# Consequências?

- **Safety of silicone breast implants**
- [http://books.nap.edu/catalog.php?record\\_id=9602](http://books.nap.edu/catalog.php?record_id=9602)
- Stuart Bondurant, Virginia Ernster, and Roger Herdman, Editors; Committee on the Safety of Silicone Breast Implants, Institute of Medicine
- **Description:**  
The Dow Corning case raised serious questions about the safety of silicone breast implants and about larger issues of medical device testing and patient education.  
**Safety of Silicone Breast Implants** presents a well-documented, thoughtful exploration of the safety of ...
- The committee concludes that there is convincing evidence that infants breast-fed by mothers with silicone gel breast implants receive no higher silicon intakes from breast milk than infants breast-fed by mothers without breast implants. Infants receiving cows' milk or commercial infant formula feedings are likely to have significantly higher silicon intakes than breast-fed infants. Evidence that any likely exposure to silicon or silicone has effects on infant health is lacking. The proportion, if any, of silicone in measurements of silicon in the samples discussed remains to be investigated. The oral toxicity of methylated siloxanes is very low, however, and these siloxanes are generally recognized as safe (for oral exposure) by the Food and Drug Administration (FDA) when used as indirect food additives as reviewed in Chapter 4 of this report (D. Benz, FDA, personal communication, 1998). Breast Implants and Problems with Breast Feeding

# Elastômeros termoplásticos

- Materiais flexíveis, com módulo de Young baixo
- Estirados até o dobro do seu comprimento original, recuperam a dimensão original quando relaxados.
- Várias famílias, substituem borrachas termofixas em escala crescente.
- Usados para modificarem poliolefinas, aumentando resistência ao impacto.

# Elastômeros termoplásticos

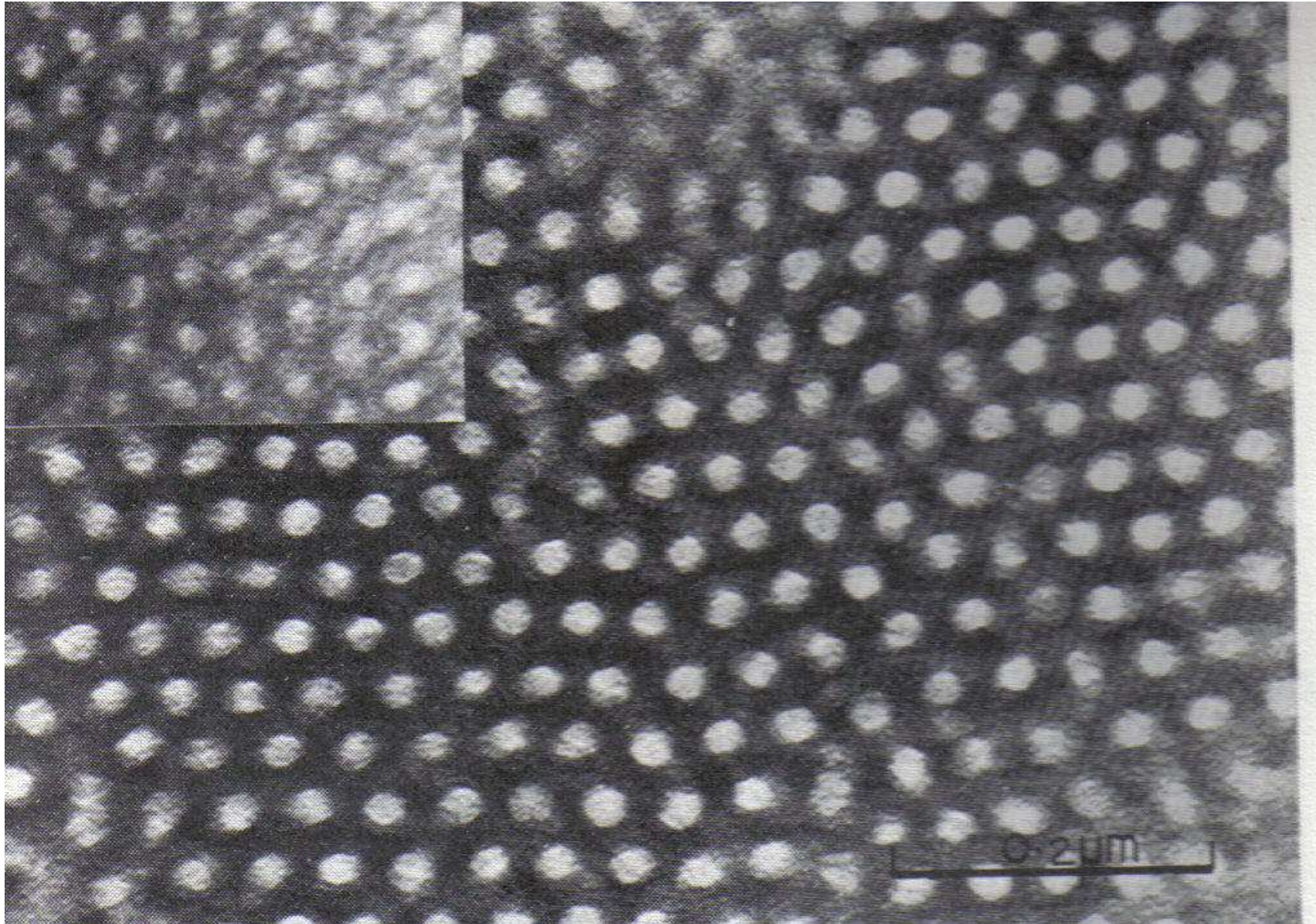
- **Classes tradicionais**

- Estirênicos (S-TPE's)
- Copoliésteres (COPE's)
- Poliuretanos (TPU's)
- Poliamidas (PEBA's)
- Blendas de poliolefinas (TPO's)
- Ligas de poliolefinas (TPV's)

- **Novos tipos**

- Blendas de reator (R-TPO's)
- Plastômeros de poliolefinas (POP's)
- Elastômeros de poliolefinas (POE's)

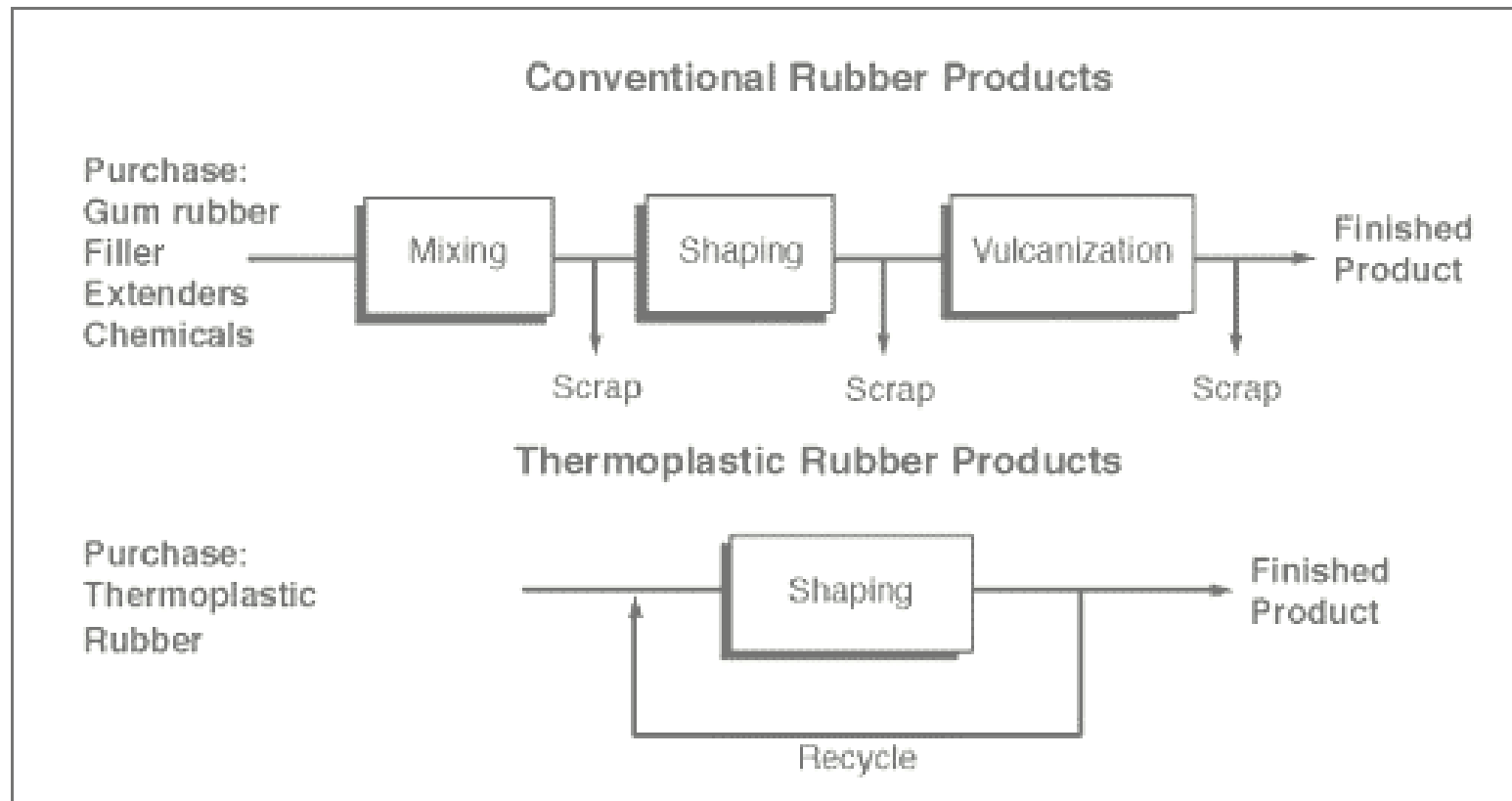
# Micrografia eletrônica de elastômero termoplástico estirênico



# Temperatura de trabalho

- **Existe uma temperatura de trabalho?**
- Depende de muitos fatores: duração da deformação, especificações de uso, forma da peça.
- Métodos de avaliação: Vicat (temperatura de amolecimento), temperatura de deflexão (HDT), Underwriter's Laboratory (UL), e outros métodos específicos de setores industriais.
- Aplicações que exigem temperaturas de serviço elevadas: automóveis/transportes, mangueiras hidráulicas, cabos de mineração.
- Aplicações menos exigentes: aplicações em ambientes internos (indoor), produtos de uso pessoal, de cozinha, cordões telefônicos, brinquedos.

# Vantagens na fabricação e na reciclagem



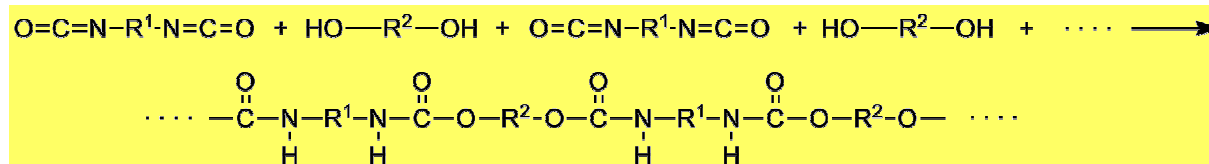


# Duas marcas importantes

- [Versollan™ elastomer alloys](#), which contain BASF Corporation High Performance Polyurethane (TPU), are a new class of soft TPU elastomers. These products have the enhanced performance characteristics of TPUs with the rubbery grip and matte finish of TPEs. The key features of Versollan alloys are:
  - Soft, rubbery feel with matte finish
  - Excellent chemical and oil resistance
  - Excellent adhesion to PC, ABS, PC/ABS
  - Easy to process with fast set-up rates
  - Flow characteristics similar to styrenic TPEs
- Manufactured by Kraton Polymers LLC, [Kraton® compounds](#) are high performance, versatile materials combining high strength and low viscosity. Several grades are available for use in a variety of applications.

# Policarbonatodiol para poliuretana termoplástica

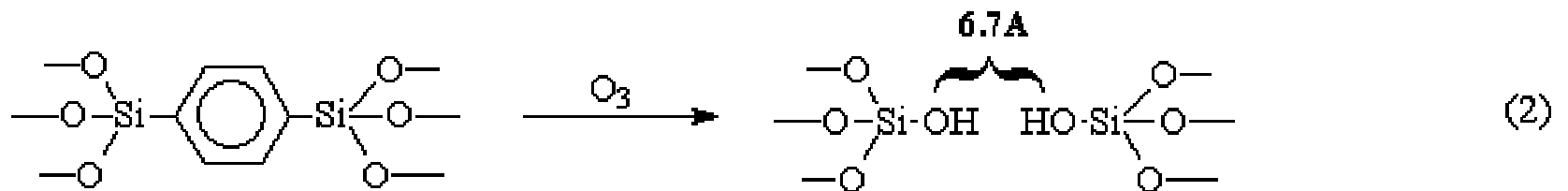
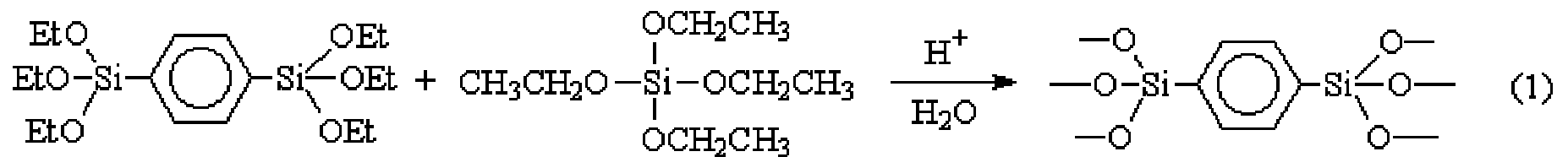
- United States Patent Application 20080146766
- Masubuchi; Tetsuo ; et al. June 19, 2008
- Polycarbonate Diol



- Abstract
- An object of the present invention is to provide a novel polycarbonate diol which is useful as a raw material compound for producing a polycarbonate-based polyurethane having a sufficient mechanical strength and excellent in a balance of physical properties such as oil resistance, hydrolysis resistance, and weather resistance and which is amorphous. The invention relates to a polycarbonate diol comprising repeating units of the below-shown formula (A) and the below-shown formula (B), wherein both terminal groups are hydroxyl groups, the ratio of the below-shown formula (A) to the below-shown formula (B) is 99:1 to 1:99 by mol, and number-average molecular weight is 300 to 10,000.
- Inventors: Masubuchi; Tetsuo; (Tokyo, JP) ; Ueno; Eizaburou; (Tokyo, JP) ; Yoshioka; Yasuyuki; (Tokyo, JP) ; Tsukimori; Yasuyuki; (Tokyo, JP)



# Formação de estruturas com porosidade controlada usando silsesquioxanos



# Conclusão

- A combinação de monômeros produz um grande número de estruturas diferentes que podem produzir uma infinidade de produtos com propriedades sintonizadas para diferentes aplicações.
- A única limitação básica é a temperatura de trabalho.

# Exercícios

1. “Polietileno” é uma enorme família de substâncias químicas. Em que aspectos estruturais um polietileno pode diferir de outro?
2. Peróxidos são usados em reações de polimerização, de reticulação e de enxertia. Mostre como isso ocorre, escrevendo as fórmulas estruturais das substâncias e as equações das reações envolvidas.
3. Comente a frase seguinte: “a reticulação de polímeros tem consequências práticas muito importantes, positivas e negativas.”
4. As propriedades de muitos polímeros mudam com o tempo. Escolha dois casos e mostre as razões químicas da mudança.
5. É possível reciclar PET fabricando poliuretanas. Escreva as fórmulas químicas e as equações que mostram isso.