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EDICIJA BEZBEDNOST U POSTMODERNOM AMBIJENTU - KNJIGA XXXVIII

MEĐUNARODNA AKADEMIJA NAUKA, UMETNOSTI I BEZBEDNOSTI - MANUB, BEOGRAD

UNIVERZITET SV. KIRIL I METODIJ, VELIKO TRNOVO, BUGARSKA

CENTAR ZA STRATEŠKA ISTRAŽIVANJA NACIONALNE BEZBEDNOSTI - CESNA B, BEOGRAD

TEMATSKI ZBORNIK RADOVA

DRUŠTVENI TRENDOVI I IZAZOVI MLADIH

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Glavni i odgovorni urednik

Prof. dr Slobodan Nešković

Beograd, 2022.

CENTAR ZA STRATEŠKA ISTRAŽIVANJA
NACIONALNE BEZBEDNOSTI-CESNA B, BEOGRAD

u saradnji sa

**Univerzitetom "Sveti Kiril i Metodij", Veliko Trnovo, Bugarska i
Međunarodnom Akademijom Nauka, Umetnosti i Bezbednosti - MANUB**

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MEĐUNARODNA NAUČNA KONFERENCIJA

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DRUŠTVENI TRENDOVI I
IZAZOVI MLADIH

IZ EDICIJE
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PREDGOVOR

Postmoderno društvo pemanentno se nalazi u raskoraku, permanentno lavirajući između progresa i degradacije, integracija i fragmentacija, razvoja i destrukcije, prosperiteta i devastacije, napretka i dehumanizacije. Brojni uticajni činioci kanališu globalne, regionalne i lokalne procese, na koji način određene pozitivne pomake neutrališu retrogradnim trendovima. Fenomeni ratova, terorizma, organizovanog kriminaliteta, konstantnih pandemija, ekoloških akcidenata, masovnih migracija, zloupotreba novih tehnologija i drugih pošasti, dramatično upućuju na bezperspektivnost ljudske populacije. Na taj način reafirmiše se i ohrabruje veoma osporavana teorija Tomasa Maltusa o sumornoj egzistenciji čovekove vrste. Poseban izazov za sve relevantne međunarodne subjekte predstavlja oružani sukob u Ukrajini gde je ratište čitav svet, vojište data država, sa bojištima u raznim delovima te zemlje. Evidentan je tradicionalni konflikt SAD i Ruske Federacije preko Ukrajine, sa sve očiglednijim katastrofalnim reperkusijama i kolateralnim žrtvama.

Socijalni, naročito politički i ekonomski odnosi na aktuelnoj planetarnoj pozornici u dužem vremenskom periodu kanalisani su permanentnim konfliktima na platformi sukoba interesa. Konfrontacije u svrsi ostvarivanja proklamovanih nacionalnih ciljeva sa stigmatizacijom suparnika na međunarodnoj pozornici, danas se vode upotrebom sofisticiranih militarističkih resursa. Postojeći međudržavni vojnopolitički savezi, odnosno transkontinentalne hegemonističke grupacije esencijalno kreiraju geopolitičku, geoekonomsku i bezbednosnu mapu globalne zajednice. Trijumfalistička prekookeanska strategija svetskih gospodara podrazumeva i formulisanje relacija između država u pojedinim regionima, saglasno strategiji vlastitih nacionalnih interesa. Navedeni postulati značajno determinišu prostor za suvereno delovanje "svetske periferije", kao sintagme označene u malim i nerazvijenim zemljama.

Globalna, međunarodna, regionalna i povezano sa njima nacionalna bezbednost težišno je koncipirana od strane vodećih aktera svetskog poretka. Kompetentno teorijsko proučavanje i razmatranje stanja od najšireg do lokalnog nivoa organizovanja međunarodnog sistema, zasniva se na korelacijama aktuelnih centara moći. Sadašnje pozicije SAD, Ruske Federacije, NR Kine i Evropske Unije predstavljaju fundamentalnu odrednicu inoviranih geostrategijskih i geobezbednosnih odnosa subjekata međunarodne zajednice. Sledstveno navedenom, profilišu se eksterne relacije državnih tvorevina na transnacionalnom, regionalnom i subregionalnom planu. Svedoci smo narastajućih antagonizama između velikih sila i njihovih sledbenika, što se neminovno manifestuje na svim delovima planete Zemlje.

Region Jugoistočne Evrope u svim etapama ljudske istorije označavao je trustno područje, kao poprište konstantnih tenzija i ratova, zasnovanih na ekspanzionističkim tendencijama moćnika. Sintagme "Bure baruta" i Čerčilova "Meki stomak Evrope" slikovito pozicioniraju posmatranu teritoriju. Taj prostor sa subregionom Zapadnim Balkanom karakteriše se tradicionalnim kontroverzama na socijalnom, ekonomskom, bezbednosnom, religijskom, vojnopolitičkom, etničkom i drugim poljima. Međunarodni položaj pojedinih država, članica ovog prostornog kolektiviteta prvenstveno je definisan političkom pripadnošću, utvrđenoj zvaničnim normativnim aktima. Prvorazredna uloga u svim oblastima njihovog bitisanja i sferi koegzistencije pripada projektima evropskih, odnosno evroatlantskih integracija. Civilizacijske kontroverze novokonstruisanog doba sa savremenim izazovima, rizicima i pretnjama, dodatno usložavaju stolećima prisutne protivrečnosti.

Transgranična saradnja država manifestuje se i sprovodi u kontekstu postojećih multilateralnih koncepcija. Objektivni hipotetički okvir ukazuje da su odgovornost, tolerancija i pomirenje ključni za normalizacija međudržavnih odnosa. To, bez obzira na konstantne balkanske kontradiktornosti, etnonacionalne i međureligijske konflikte koji se gotovo ciklično ponavljaju. Institucionalna rešenja koja do danas nisu dobila konkretnu satisfakciju, ogledaju se u uspostavljenim regionalnim inicijativama: Proces

saradnje u Jugoistočnoj Evropi, Pakt za stabilnost Jugoistočne Evrope, Regionalni savet za saradnju, Jadransko - Jonska inicijativa, Centralnoevropska zona slobodne trgovine - CEFTA i druge. Prema ingerencijama Evropske Unije potpisani su sporazumi u oblastima parlamentarne saradnje, spoljne trgovine, saobraćaja, bezbednosti, zaštite životne sredine, energetike i civilnog društva.

Evidentno je da postoji veliki broj utemeljenih projekata stvorenih u cilju normalizacije i razvoja odnosa zemalja u susedstvu, regionu Jugoistočne Evrope odnosno subregionu Zapadni Balkan, oličen u afirmativnom konceptu "Otvoreni Balkan". Egzistiraju brojna krizna žarišta, pre svega Kosovo i Metohija, Pridnjestrovlje (Transnistrija), Severni Kipar, odnosno delikatne relacije Srbija - Hrvatska, Srbija - Crna Gora, Srbija - Albanija i Grčka - Turska. Osnovna kontroverza jeste fragmentaran metod razrešavanja konfrontacija, tako da su navedeni projekti rezultat nastojanja Evropske Unije i vodećih međunarodnih činilaca, a mnogo manje samih balkanskih tvorevina. Koncepti u vidu "zamrznutog stanja" su neodrživi, što potvrđuju stalni sukobi Jermenije i Azerbejdžana oko pokrajina Nagorno Karabah u regionu Južnog Kavkaza, Abhazije i Severne Osetije sa vlašću u Gruziji, zatim Kine i Tajvana, konflikt Severne i Južne Koreje, Indije i Pakistana oko Kašmira i drugi. Stoga, podržavamo sva nastojanja za postizanje rešenja za Kosovo i Metohiju u kontekstu Ustava Republike Srbije i očuvanja mira u svetu.

Aktuelna pandemija COVID - 19 sa dramatičnom eskalacijom i kafastrofalnim reperkusijama imperativno zahteva sveobuhvatan pristup u obuzdavanju te ogromne pošasti. Uspostavljene paradigme međudržavne saradnje i projekti kooperacije znanja moraju se potpuno implementirati u akutnoj sferi ljudske egzistencije. Krucijalna ulogu u eliminisanju korone virusa pripada nauci, koja po definiciji rešava probleme ljudi i čovečanstva. To označava vrhunski, najatraktivniji izazov za sve pripadnike akademske zajednice u svetu. Zalažemo se za integrisan princip na svetskom nivou, uključujući parcijalna istraživačka dostignuća pojedinih država i institucija. Podrazumeva se odbacivanje separatnih politički i ekonomski motivisanih koncepcija u prevenciji i lečenju ljudi.

Na ovom mestu predstavljamo Tematski Zbornik radova, knjiga 38., DRUŠTVENI TRENDOVI I IZAZOVI MLADIH, autentičan konglomerat kompetentnih radova priznatih akademskih poslenika iz zemlje i inostranstva. Pri tome, kontinuirano se implementira strateški koncept analiziranja temata multidisciplinarnim pristupom, sa većeg broja uspostavljenih aspekata. Suizdavači su istovremeno i suorganizatori zapaženih konferencija međunarodnog značaja održanih 12. jula u Kruševcu i 30. septembra - 01. oktobra na Rudniku. Poslednji skup označava 108. Konferenciju CESNA B, što je nedumljivo jedinstven poduhvat u Srbiji i širem okruženju. U navedenom kontekstu je i predstojeća Konferencija u Beogradu, četvrta u tekućoj godini. Posebnu dimenziju predstavlja višekriterijumsko razmatranje položaja mladih u aktuelnom društvenom ambijentu, u svrsi naučnog doprinosa akademskoj zajednici, naročito u sferi koncipiranja nedostajuće esencijalne Strategije nacionalnih interesa Republike Srbije i ostalih deficitarnih doktrinarnih dokumenata.

U Beogradu,
08. decembar 2022. godine

Prof. dr Slobodan Nešković

PREFACE

Post-modern society is permanently in a gap, constantly vacillating between progress and degradation, integration and fragmentation, development and destruction, prosperity and devastation, progress and dehumanization. Numerous influential factors channel global, regional and local processes, in which way certain positive developments are neutralized by retrograde trends. The phenomena of wars, terrorism, organized crime, constant pandemics, environmental accidents, mass migrations, misuse of new technologies and other plagues dramatically point to the hopelessness of the human population. In this way, Thomas Malthus's much disputed theory about the gloomy existence of the human species is reaffirmed and encouraged. A special challenge for all relevant international subjects is the armed conflict in Ukraine, where the battlefield is the whole world, the battlefield of a given country, with battlefields in various parts of that country. The traditional conflict between the USA and the Russian Federation over Ukraine is evident, with increasingly obvious catastrophic repercussions and collateral victims.

Social, especially political and economic relations on the current planetary stage for a long period of time have been channeled by permanent conflicts on the platform of conflicts of interest. Confrontations for the purpose of achieving proclaimed national goals with the stigmatization of rivals on the international stage are conducted today with the use of sophisticated militaristic resources. Existing interstate military-political alliances, i.e. transcontinental hegemonic groups essentially create the geopolitical, geoeconomic and security map of the global community. The triumphalist transoceanic strategy of the world masters also implies the formulation of relations between states in certain regions, in accordance with the strategy of their own national interests. The aforementioned postulates significantly determine the space for the sovereign action of the "world periphery", as a phrase marked in small and underdeveloped countries.

Global, international, regional and related national security is mainly conceived by the leading actors of the world order. Competent theoretical study and consideration of the situation from the broadest to the local level of organizing the international system is based on the correlations of the current centers of power. The current positions of the USA, the Russian Federation, the People's Republic of China and the European Union represent a fundamental determinant of the innovative geostrategic and geosecurity relations of the subjects of the international community. As a result of the above, the external relations of state creations on the transnational, regional and subregional level are profiled. We are witnessing the growing antagonism between the great powers and their followers, which inevitably manifests itself in all parts of the planet Earth.

In all stages of human history, the region of Southeast Europe was a trust area, as a scene of constant tensions and wars, based on the expansionist tendencies of the powerful. The phrases "Powder Keg" and Churchill's "Soft Belly of Europe" vividly position the observed territory. That area with the Western Balkans subregion is characterized by traditional controversies in the social, economic, security, religious, military-political, ethnic and other fields. The international position of individual states, members of this spatial collectivity, is primarily defined by political affiliation, determined by official normative acts. The first-class role in all areas of their existence and the sphere of coexistence belongs to the projects of European, that is, Euro-Atlantic integration. Civilizational controversies of the newly constructed age with contemporary challenges, risks and threats further complicate the contradictions present for centuries.

Cross-border cooperation of states is manifested and implemented in the context of existing multilateral concepts. The objective hypothetical framework indicates that responsibility, tolerance and reconciliation are key to the normalization of interstate relations. This, regardless of the constant Balkan contradictions, ethno-national and inter-religious conflicts that are repeated almost cyclically. Institutional solutions that have not received concrete satisfaction to date are reflected in the established regional

initiatives: the Cooperation Process in Southeast Europe, the Pact for the Stability of Southeast Europe, the Regional Cooperation Council, the Adriatic-Ionian Initiative, the Central European Free Trade Area - CEFTA and others. According to the authorities of the European Union, agreements were signed in the areas of parliamentary cooperation, foreign trade, traffic, security, environmental protection, energy and civil society.

It is evident that there is a large number of well-founded projects created with the aim of normalizing and developing relations between countries in the neighborhood, the region of Southeast Europe, i.e. the subregion of the Western Balkans, embodied in the affirmative concept of "Open Balkans". There are numerous crisis hotspots, primarily Kosovo and Metohija, Transnistria, Northern Cyprus, i.e. the delicate relations between Serbia - Croatia, Serbia - Montenegro, Serbia - Albania and Greece - Turkey. The main controversy is the fragmentary method of resolving confrontations, so that the mentioned projects are the result of the efforts of the European Union and leading international actors, and much less of the Balkan creations themselves. Concepts in the form of a "frozen state" are unsustainable, as confirmed by the constant conflicts between Armenia and Azerbaijan over the provinces of Nagorno-Karabakh in the South Caucasus region, Abkhazia and North Ossetia with the authorities in Georgia, then China and Taiwan, the conflict between North and South Korea, India and Pakistan over Kashmir and others. Therefore, we support all efforts to achieve a solution for Kosovo and Metohija in the context of the Constitution of the Republic of Serbia and the preservation of peace in the world.

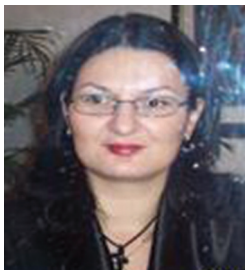
The current COVID-19 pandemic, with its dramatic escalation and catastrophic repercussions, imperatively requires a comprehensive approach in curbing this enormous scourge. Established paradigms of interstate cooperation and knowledge cooperation projects must be fully implemented in the acute sphere of human existence. A crucial role in eliminating the corona virus belongs to science, which by definition solves the problems of people and humanity. It marks the ultimate, most attractive challenge for all members of the academic community in the world. We stand for an integrated principle at the world level, including the partial research achievements of individual countries and institutions. It implies the rejection of separate politically and economically motivated conceptions in the prevention and treatment of people.

Here we present Thematic Proceedings, Book 38, SOCIAL TRENDS AND CHALLENGES OF YOUTH, an authentic conglomerate of competent works by recognized academics from the country and abroad. At the same time, the strategic concept of analyzing topics with a multidisciplinary approach, from a larger number of established aspects, is continuously implemented. The co-publishers are also co-organizers of notable conferences of international importance held on July 12 in Kruševac and September 30 - October 1 in Rudnik. The last gathering marks the 108th CESNA B Conference, which is unquestionably a unique endeavor in Serbia and the wider environment. The upcoming Conference in Belgrade, the fourth in the current year, is also in the aforementioned context. A special dimension is the multi-criteria consideration of the position of young people in the current social environment, with the aim of scientific contribution to the academic community, especially in the sphere of designing the missing essential Strategy of National Interests of the Republic of Serbia and other deficient doctrinal documents.

In Belgrade,
December 8, 2022

Full Professor Dr. Slobodan Nešković

S A D R Ž A J




Sonja B Ketin[1], Boban Kostić[2]

TECHNOLOGY OF POLYPROPYLENE

Abstract

The paper presents the most important technology for the production of polypropylene (Spheripol, Novolen, Innovene, Unipool, Borstar), as well as the latest achievement in the field of propylene polymerization and Montell's process of circulating current. Considered the representation of different ways polymerization medium annual growth rate of the latest installed capacities and production processes.

Keywords: polypropylene, production, technology

Introduction

Commercial production of polypropylene (PP) began in 1957. Today, PP is the second largest global volume polymer business and accounts for roughly 25% of total polymer demand. Over 61 million tonnes are consumed by markets ranging from automotive to medical, with China consuming almost one-third of total PP demand.

To manufacture homopolymer polypropylene, the following are required:

- Polymer grade propylene
- Catalyst
- Polymerization reactor
- Extruder/pelletiz

To manufacture polypropylene copolymer, a second monomer is required Ã¢Â□Â“ typically ethylene. The manufacture of homopolymer or random copolymer can be accomplished within a single reactor, whereas the manufacture of impact copolymer or TPOs necessitates at least two reactors in series.

Propylene monomer, also known as 1-propene, is one of the smallest stable unsaturated hydrocarbon molecules used in the gas industry. Roughly two-thirds of global propylene production goes to produce polypropylene. The majority of all propylene monomer is manufactured in commercial quantities via (1) as a byproduct of

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catalytic cracking in a petroleum refinery or (2) as a by-product of the dominant olefin ethylene in the steam pyrolysis process of a chemical cracker. The balance is produced via on-purpose routes including propane dehydrogenation (PDH), coal-to-olefins (CTO), methanol-to-olefins (MTO), methanol -to-propylene (MTP) and metathesis.

Three grades of propylene are commonly traded throughout the world, based primarily on the propylene content, but also upon the level of certain critical impurities. These grades are their usual purity levels are:

- Polymer Grade (PGP): 99.5% propylene (minimum), used to produce polypropylene
- Chemical Grade (CGP): ~92-96% propylene, used to produce solvents and intermediate chemicals
- Refinery Grade(RGP): ~60-70% propylene, upgraded (split) into purer grades or utilized to produce cumene or alkylate

There are five basic polypropylene production processes:

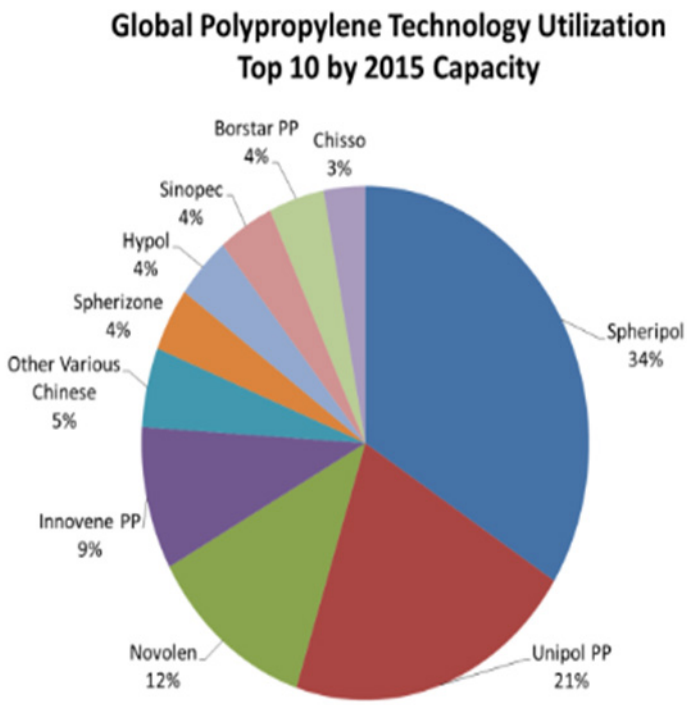
1. Solution polymerization
2. Slurry (or diluent) polymerization
3. Gas phase polymerization
4. Bulk (or liquid polypropylene) polymerization
5. Hybrid (bulk plus gas phase) polymerization

The catalyst is the key component that influences the productivity and economics of the process and determines certain properties of the polymer. Historically, catalyst improvements have been commercialized progressively, as follows:

- High activity Ziegler-Natta catalysts have increased the productivity of the process and eliminated the need for catalyst removal from the polypropylene, thereby reducing production costs;
- High stereospecificity Ziegler-Natta catalysts have increased the yield of isotactic polypropylene in the process, thereby eliminating the need to remove atactic polypropylene and further reducing production costs; and
- Metallocene catalysts have improved certain polymer properties for isotactic polypropylene, and have also provided the opportunity to produce on-purpose syndiotactic and atactic polypropylene.

Ziegler-Natta catalyst suppliers are continuing to make improvements in catalyst productivity and selectivity. Metallocene catalysts were first used to produce quantities of polypropylene in 1995, brand name Achieve by Exxon. Since then, metallocene polypropylene grades have been produced commercially and are delivering superior properties which are valuable in certain end-use market segments especially high MFI fiber grade and injection molded parts.

There are nine major suppliers of polypropylene technology, offering unique variations of the five basic production processes. Currently, Spheripol has the largest share of global installed capacity, followed by Unipol PP and Novolen.



Source:Tousend Solutions

LyondellBasell (formerly Basell Polyolefins, Himont, Montell)

In Basell's Spheripol process, homopolymerization is carried out in the liquid phase using a high activity/high stereospecificity catalyst system, which includes a MgCl2 supported titanium catalyst in spherical form. Liquid propylene and the catalyst system are fed continuously into a loop reactor together with hydrogen (for controlling molecular weight); ethylene is added to produce random copolymers. Polymerization occurs at temperatures of 60 to 80oC and at pressures of 3,500 to 4,000 kPa. The reaction vessel is cooled by using a water jacket. Spheres of polymer form as a slurry; the granules can then be fed to a gas phase copolymerization reactor, and unreacted monomer is condensed and recycled. Gaseous ethylene and propylene are copolymerized on a fluid bed of polymer particles; the composition of the spherical impact copolymer can be controlled by changing the amount of gases that are recycled. Solid products are finally treated on a fluid bed to deactivate the residual catalyst and to remove volatiles. The Spheripol process was developed by Himont/Montedison using technology devised under a cooperative research and development agreement with Mitsui Petrochemical of Japan. In 2002, Basell commercialized the Spherizone process. This new process uses a multizone-circulating reactor with bulk and gas phase zones separated by a barrier fluid.

Borealis

Borealis offers for license Borstar PP, a multiple reactor polymerization technology based upon an extension of their Borstar polyethylene process. Borstar PP consists of a slurry loop reactor, followed by a number of gas phase reactors in series. Two, three or four reactor configurations are available depending on the type of polypropylene required. Borealis has demonstrated the feasibility of this new technology by constructing their first 200 thousand tonnes line at Schwechat, Austria.

Ineos (formerly BP Chemicals)

In 1999, BP Chemicals acquired Amoco Chemicals and has since restructured its polypropylene and polyethylene businesses. As part of this restructuring, Amoco's and BP Chemicals'Â□Â™ licensing businesses were combined. The polypropylene technology originally developed by Amoco is now offered under the brand Innovene PP. This gas phase polymerization technology uses a horizontal stirred bed process operating at 2,200 kPa. Only one reactor is used to produce homopolymers and random copolymers; two gas phase reactors in series are used to produce impact copolymers. The unique reactor reportedly allows near plug flow (a linear flow of the propylene/ polypropylene through the reactor, versus a random removal with recycling). The near plug flow, in turn, provides a much narrower molecular weight distribution than a back mixed reactor, as the residence time of each molecule is very nearly the same.

Chisso

Chisso co-developed the horizontal gas phase polymerization process with Amoco, and they co-licensed this technology for a number of years. This cooperative arrangement has since ended, and Chisso under JPP now offers its own version for license.

Grace

Dow entered the polypropylene licensing business in 2001 through its acquisition of Union Carbide. The Unipol PP process is based upon an extension of Union Carbide's gas phase polymerization technology which was originally developed to produce polyethylene. The SHAC Catalyst technology, which Union Carbide acquired from Shell, involves a high activity titanium chloride/triethyl aluminum-based catalyst. The dual reactor configuration can produce a complete range of commercial polypropylene grades. Dow then developed Advanced Donor Technology (ADT) and produced non-phthalate PP catalysts. Grace purchased Dow's PP catalyst/licensing business on October 11, 2013. All Dow's PP technologies now belong to Grace.

Mitsui Petrochemical

The Hypol polymerization process utilizes a high activity, high stereospecificity catalyst which was developed jointly by Himont/Montedison and Mitsui. First-generation Hypol technology is based upon a hybrid process, which uses a bulk stirred tank reactor for the first stage and a gas phase reactor for the second stage. In second-generation Hypol II units, a bulk loop reactor is used for the first stage. In either case, homopolymers and random copolymers are made in an auto-refrigerated adiabatic vessel using the bulk polymerization process. Impact copolymers are then made in the second stage gas phase reactor. Line configurations with more than two reactors have been used in order to manufacture polymers with specific characteristics or properties.

Novolen Technologies

As a consequence of the merger between Montell Polyolefins and Targor to form Basell, licensing rights to the Novolen process were divested to a separate company called Novolen Technologies Holdings, an 80/20 percent joint venture between ABB Lummus and Equistar. Originally developed by BASF, the Novolen process is based upon gas phase polymerization technology using a vertical stirred powder bed at 50 to 105Â¬oC. and 2,500 to 4,000 kPa. A modified Ziegler-Natta catalyst is used for high polymerization yield. Only one reactor is necessary to produce homopolymers and random copolymers, while a cascade of two gas phase reactors is used to produce impact

copolymers.

A two-reactor system can manufacture strictly homopolymer at up to 130 percent of the designed plant capacity as both reactors are utilized to manufacture homopolymer. Cooling is provided by vaporizing liquid propylene, which is injected into the reactor, condensed, re-injected and recycled continuously. Polypropylene powder is discharged periodically from the reactor into a vessel for downstream cleansing, finishing, and pelletizing.

Rexene

In the Rexene or El Paso process, polypropylene homopolymers and copolymers can be produced in a single-train plant (up to 150,000 tonnes/year). Homopolymers and random copolymers are produced via a liquid pool process in a single stirred tank reactor. Impact copolymers are made by on-line transfer of the polymers to a gas phase copolymer reactor system. The process uses high-yield catalysts, and the removal of catalyst residues and atactic polymer is not required.

Sumitomo Chemical

Sumitomo offers gas phase polymerization technology using a fluidized bed reactor. Only one reactor is necessary to produce homopolymers and random copolymers; a cascade of two gas phase reactors is used to produce impact copolymers. Proprietary fourth generation catalyst technology has also been developed. The combination of the catalyst and process technology has enabled Sumitomo to manufacture very high MFR grades, highly crystalline PP, and high ethylene-propylene rubber content copolymers.

Leading global PP production plants

The global PP market is led by several leading producers worldwide, located in the United States of America, Asia, and the Middle East [10]. These PP producers vary in terms of the technology used for the manufacturing of PP resin and the various PP grades produced and supplied to the market. The three main PP producers in the Middle East, considered the leading PP producers in the region, are ARAMCO in Saudi Arabia, BOROUGE in the United Arab Emirates, and EQUATE in Kuwait. In 2012, the GCC's manufacturing sector, including the petrochemical industry, has contributed to nearly 9.3 % of the region's gross domestic product (GDP). The value-added contribution of the manufacturing sector, as of 2012, was estimated to be the US $143.6 billion. Strictly speaking, petrochemicals and chemicals represent 31 % or the US $45.2 billion of the total value-added to the economy[20]

Breaking this down further and looking at the figures country-wise, Saudi Arabia's manufacturing industry contributed to 10.1 % of the real GDP in 2012. The improved contribution to the manufacturing sector in 2012 was estimated to be the US $71.6 billion. In 2012, the industrial region of the UAE grew by 11.7 %, in contrast with the preceding year, where only 9 % was added to the GDP. The manufacturing sector, which includes the chemical and refining sector, represented 9.9 % of Qatar's nominal GDP in 2012, with 8 million tons per annum production capacity. By volume, PP is classified as one of the largest growing polymers in the GCC, accounting for 34 % of the total. Over the past five years, PP capacity growth has been one of the highest among other polymers in the region. Between 2008 and 2012, the average annual expansion rate of CAGR (Compound Annual Growth Rate) was 23.6 %, and PP production increased from 3.4 million tons a year in 2008 to 8 million tons per year in 2012. Thus, the export production of the GCC expanded at an average rate of 10.4 %, placing it among the top

compared with other regions. For example, compared with Asia, the production growth rate was estimated to be only 8.6 %, closely following the GCC region. According to the latest reports released in 2016 by the Gulf Petrochemicals and Chemicals Association (GPCA), the capacity of the GCC polymer industry has been expanded by 5 %, which makes it reach 27.1 million tons, and it is expected to continue growing by 3 % per annum by 2022 [14]. The PP production capacity represents 27.9 % of the total 27.1 million tons GCC polymer production capacity, whereas the global PP capacity was estimated to be 73.7 million tons, and the GCC region represents 7.6 % for overall global PP production capacity per annum. The main leaders for the polyolefins industry growth are Saudi Arabia which represents 11 % CAGR per annum, Oman with 10.7 % CAGR per annum, and United Arab Emirates which has the highest contribution, 24.2 % CAGR per annum for the period 2006 up to 2016. In 2016, the GCC contributed to 9 % of the 300 million tons of the global thermoplastic capacity, and the local polymer consumption has been increased by 4 % which makes it reach 5 million tons[20].

Technology procedures and details

All up-to-date methods to obtain polypropylene are based on the polymerization in the mass of monomers that in the reactor can be in liquid or gaseous state.

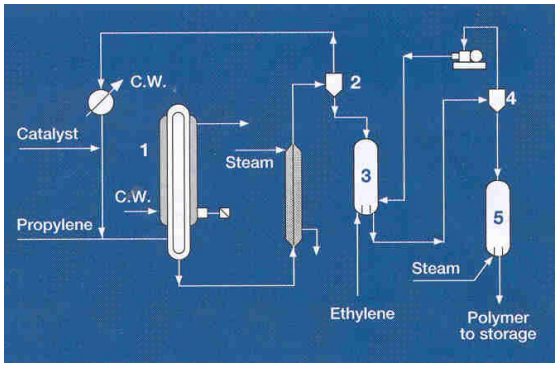
The most important method of obtaining a polypropylene in the mass of a liquid monomer is Montell's (nowadays Basell) Spheripol's process. The reactor is a double loop pipe with screen where counter-flowing cooling water. The reactor is a relatively small volume and through it in the turbulent regime flow the suspension of the polymer powder in a liquid monomer. The velocity of flow in the reactor is large (about 10 m/s) {it contributes to the homogeneity of the product and allows the removal of large amounts of heat}.

Production processes in the gas phase can be divided into three groups:

- the first group consists of '' Unipol '' process using fluidized layer which has been affirmed by the Union Carbide company
- the second group includes methods of obtaining in the horizontal reactor with a mixer where the most important is Amoco's '' Innovene'' process
- the third group includes methods of obtaining in a vertical reactor with a mixer where the most important is BASF's "Novolen" 'process.

A special procedure is "Borstar" which is a combination of existing (loop) reactors and reactors in the gas phase, which is developed by Borealis company. Novoline and Innovene process are similar. Mixer allows a good homogeneity and heat dissipation is performed by condensation of recycled propylene. Unipol process involves forming a fluidized bed in the lower part of the reactor which is maintained by flowing of the gas through the distribution panel. The flowing of the gas through the fluidized bed provides good mixing and heat dissipation. In recent years, in order to better heat dissipation there takes place and the condensation of the recycled gas. In addition to these there are any commercial operations in the suspension but they will not be discussed separately because they are overcome from the standpoint of investment and operational costs, and practically these production lines are no longer being built.

Spheripol procedure



1-reactor
2-separator of unreacted monomer flashing-flush vessels
3-impact reactor
4-separator of unreacted monomer flashing-flush vessels
5-separator-separation of residues unreacted monomer by steam

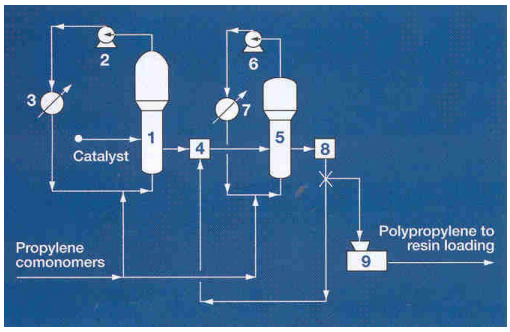
Type and characteristics of the reactor

The reactor is of the type of tube in the tube, circular shape, high altitude and relatively small volume. Prior to the ethylene reactor and the catalyst, they are introduced into the prepolymerization reactor with the purpose of better utilization of the catalyst, more stable operation of the reactor, homogeneity and morphology of the polymer obtained. The suspension of the polymer powder in the monomer is flowing in the tube. The flow is turbulent, at a speed of about 10 m / s, which ensures excellent homogeneity of the product. Cold water runs counterclockwise in the envelope.

Process conditions: 15-33 bar, 650C

Catalyst type: The catalyst consists of highly active TiCl4, an electron donor MgCl2 and alkylaluminum

Unipol procedure



1-reactor
2-centrifugal recirculating gas compressor for the first reactor
3-cooler gas turbine
4-way reservoir for impact reactor
5-impact reactor
6-centrifugal recirculating gas compressor for the second reactor
7-cooler gas turbine for the second reactor
8-receptacle
9-granulation

Type and characteristics of the reactor

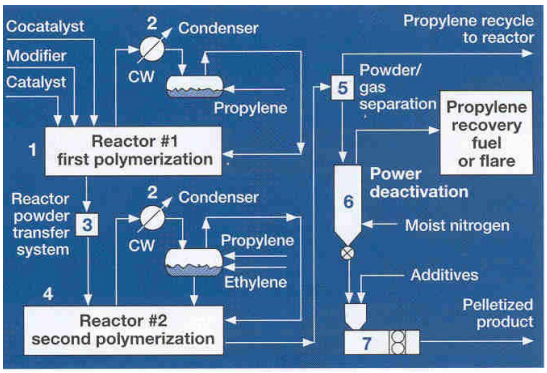
The reactor is a pear-shaped vessel with an extension to the top of the reactor. There is a much larger volume than all of those listed. The reactor is practically divided into two zones of the fluidized bed and the impoverishment zone. Heat is driven by cold propylene, which is introduced into the reactor by a nozzle system through the distribution plate, where it forms a fluidized bed. This system ensures good mixing and high product homogeneity.

Process conditions: 15-30 bar, 700C

Catalyst type: The catalyst supplies the licensor in barrels in the form of a

suspension in mineral oil. These are the basis of the IV generation catalysts titanium, carrier MgCl2, catalyst and donor of electrons (Luis base)

Innovene procedure



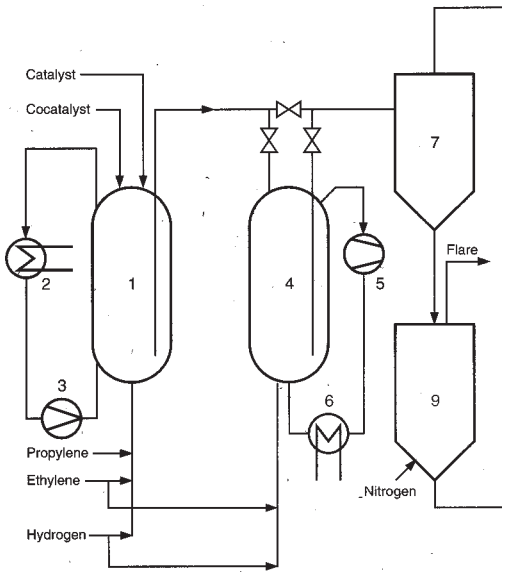
1-reactor
2-capacitor
3-pump for powder transport
4-impact reactor
5-separator of unreacted gas
6-deck for deactivation and separation of residue propylene that goes to regeneration or to torch
7-extruder

The reactor is a horizontal vessel with a mixer that ensures the homogeneity of the product. It is similar to that of the previous one. A special feature is the construction of the interior of the reactor and the mixer itself, so it should ensure the flow of ethylene through the reactor without re-mixing. In this way, the equilibrium retention time of ethylene and powder in the reactor should be ensured, which would significantly increase the homogeneity of the product. Ethylene is introduced into the liquid phase reactor where it is currently evaporating - which keeps the system cool.

Process conditions: 20-40 bar, 650C

Catalyst type: Ti / Mg / Ethylbenzoate and the catalyst is three isobutyl aluminum

Novolen procedure



1-reactor
2-cooler / condenser gas recycle
3-pump
4-impact reactor
5-pump
6-cooler / condenser gas recycle
7-separator of unreacted propylene
8-separation of residual propylene from powder and deactivation

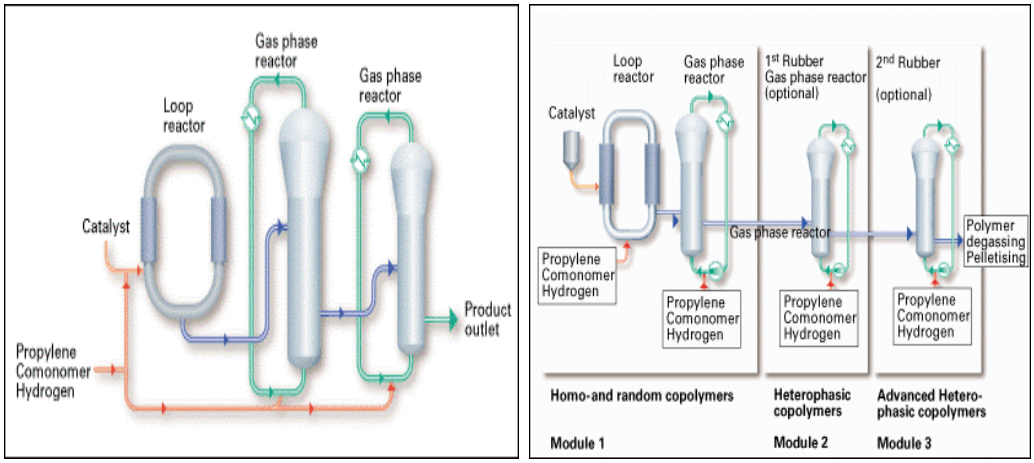
Type and characteristics of the reactor

The reaction takes place in a vertical reactor with a mixer whose volume is 25-75 m3 depending on the required capacity. For maximum dispersion, the catalyst is injected directly into the mixing center by a nozzle system. The heat of the polymerization was neutralized by evaporating the condensed gas recycle. Very small quantities of hydrogen are added for fine regulation of the melt index.

Process conditions: 20-40 bar, 50-900C

Type of catalyst: PTK catalyst IV generation. CheeseTi / Mg as cocatalyst aluminum diethyl chloride and ethylbenzoate. The same catalyst is used for the complete production program.

Borstar procedure



Type and characteristics of the reactor

The process is a combination of a tubular reactor of a circular shape and a vertical reactor in the gas phase, which results in increased process flexibility, easier control of the distribution of molecular masses and even distribution of comonomers. If the production of heterophase copolymers is desired, one or two additional reactors may be used in the gas phase.

Process conditions: 25-35 bar, 80-900C

Catalyst type: classic Zigler-Natta, single-site, metallocene and specially developed Zigler-Natta in Borealis can be used, which allow operation at high temperatures, below and below the critical temperature of the reaction medium.

Table 1. Review of new polypropylene capacity in the world

Country	Company	Place	Capacity	Licencor	Engineering
Egypt	Anchor Benitoite	Suez	590 KTA	Novolen	Lummus
Pakistan	Engro	Karachi	750 kta	UNIPOL®	Honeywell UOP and
China	SinochemHongrun Petrochemical	Qingzhou		PP	W.R. Grace
China	Lummus Technology of Houston	Jinzhou City	450KTA	UNIPOL	W.R. Grace Lummus
			900KTA	Novolen	

Source:Hydrocarbon Processing HPI Construction Boxscore, 2021

Involvement of procedures for prolypolene production

Figure 1 shows that ten years ago the most common procedure for obtaining polypropylene was in suspension. Today the situation is completely different prevailing practices in the mass of the monomer and the gas phase. Figure 2 shows that the highest annual growth rate of installed capacity have procedures in mass (Spheripol process) and in the gas phase. Figure 3 presents installed capacities in kt where it is evident that the classical procedures in the suspension no longer should be considered.

Figure 1. Procedure for obtaining polypropylene and paecentage part

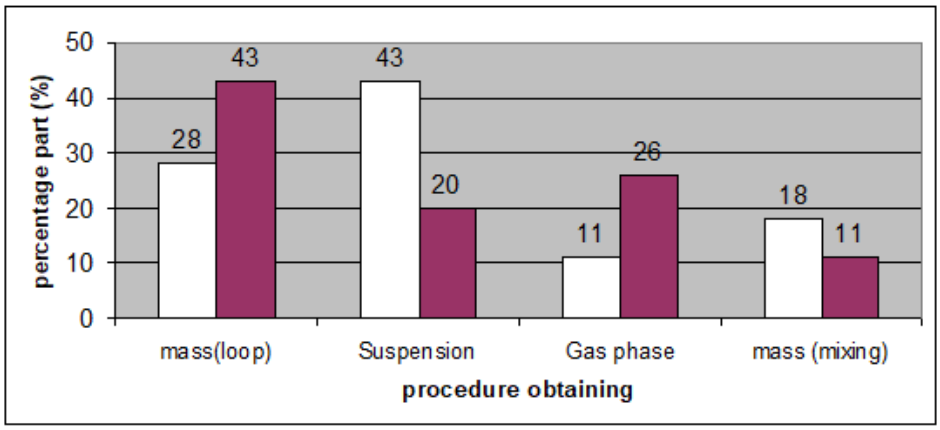


Figure 2. Procedures in mass (Spheripol process) and in the gas phase and paecentage part

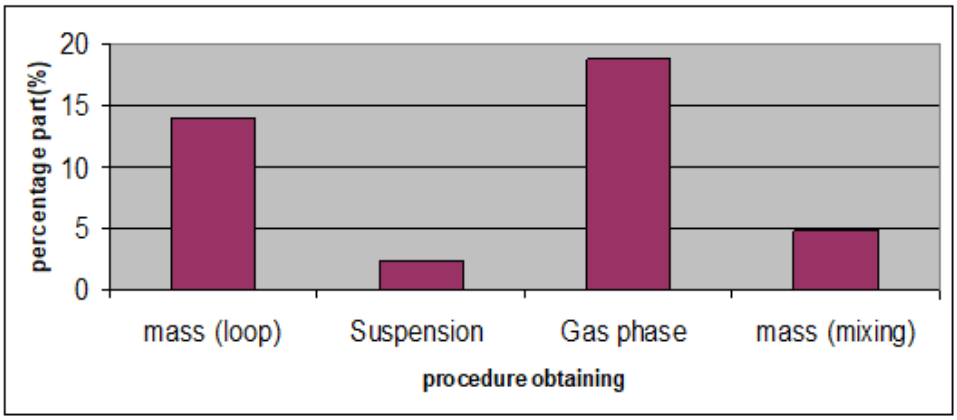
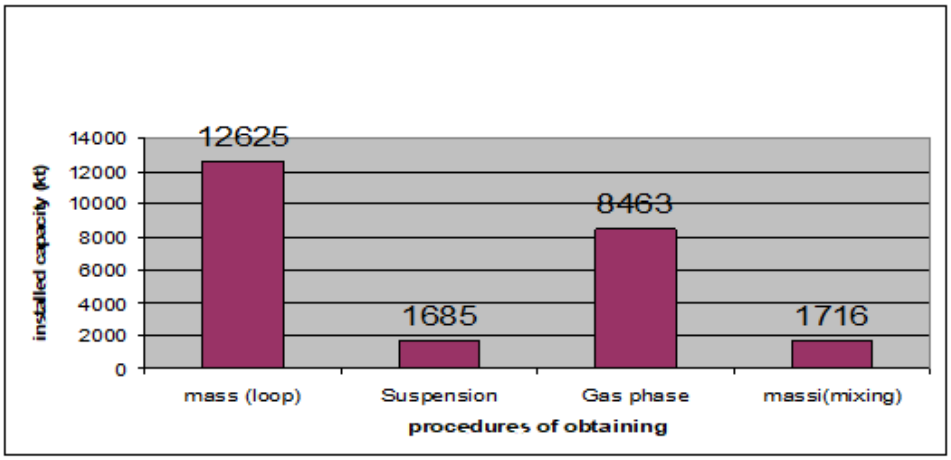


Figure 3. Classical procedures (mass, suspension, gas phase and massi) and insralled Capacity



Montell's up-to-date procedure of polypropelen production

Recently was launched the magazine ("Modern Plastics") that is possible to perform polymerization of propylene by improved process which represents the improved version of Spheripol's process(Figure 4). The essence of the process is that in the reactor there are different dynamics of flow through two interconnected zones, such as:

1. zone of ''fast'' flow through a kind of fluidized bed in a gas stream with a high concentration of hydrogen
2. zone of slower flow through densely packed layer of polymer particles in liquid propylene

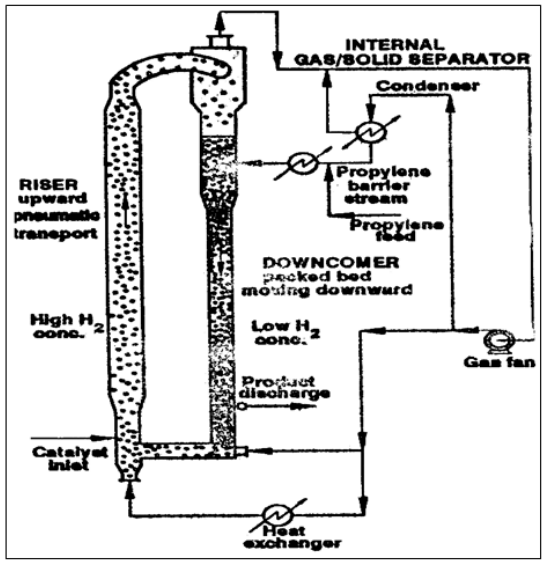


Figure 4. An advanced version of Spheripol procedure

In the zone of rapid flow the particles are moving up pneumatically in the air stream of highly concentrated hydrogen. At the top is done separation of particles of gas, which is now entering in the second so-called densely packed zone. This zone is made up of liquid propylene with a low concentration of hydrogen and densely packed polymer particles. Here is additionally add monomer or co-monomer which affects the physical properties of the growing polymer. The hydrogen gas concentration can also affect the molecular mass of the polymer that is at its flowing index. The particles of the formed polymer have a diameter of 0.2 to 5 mm. This regime of flow through the reactor should increase the flexibility of the process in terms of increasing the range of finished products and improved properties obtained polypropylene.

Conclusion

There has been a continuous improvement of existing technologies in terms of used catalysts, as well as the conditions of polymerization.

In terms of the representation of certain commercial practices in the course of the last ten years there has been a rising trend in the process of mass and in the gas phase, while the processes in suspension is underrepresented. In recent years is noticed the trend of increasing capacity of single lines so that they mainly build plants; Though so far the represented commercial procedures have shown great efficiency and economic cost of production there constantly have been making the new enhancements to improve the quality of products, new applications and economy of the process. The long-term outlook for polypropylene is positive as the promise of abundant, low-priced propylene supports continued PP growth and attractive margins.

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