PPS Newsletter

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November 2020 Information to Polymer Processing Society Members

Letter from the PPS President

The COVID-19 pandemic impacts the social and economic activities in the whole world. Like most of Scientific Societies, the Polymer Processing Society (PPS) suffers from this situation. Our 2020 PPS-36 Montreal (Quebec, Canada) International Conference has been postponed for September 2021. The Autumn 2020 Bengaluru (India) Regional (Asia-Australasia) Conference has been cancelled. We hope that the health situation will improve in the following months and that the planned conferences can be held on the scheduled dates and thus allow these scientific exchanges, which are the richness of PPS.

In order to maintain the scientific activities of the Society in this difficult period, the PPS Executive Committee, in close cooperation with the International Representatives, decided to launch Webinar and Short Courses dedicated to our members at special fees. The first Webinar will be organized in January 2021 by Professor Sadhan Jana from the University of Akron, Ohio, USA. We hope that other proposals will emerge at International or Regional levels under the banner of PPS. You may contact for that purpose your International Representatives (list and e-mail addresses in Appendix) as well as Professor Sadhan Jana who will coordinate the Webinar program.

The PPS membership is decreasing because most of the members apply for membership when they register for a conference. This obviously impacts the finances of the Society. May we kindly ask our active members to renew their membership as soon as it is over, and our lapsed members, who found in the past their interests in PPS activities, to apply again for membership? To make a payment please visit www.tpps.org, and then click JOIN/RENEW.

We hope that you remain healthy and that we will have the pleasure to meet again in the next months.

Jean-François Agassant
PPS President

PPS Webinar on Friday, January 15, 2021: ADDITIVE MANUFACTURING

A PPS Webinar on Additive Manufacturing is scheduled for **Friday, January 15, 2021**.

Registration information will be e-mailed to all recipients of this newsletter, by December 20.

The webinar is planned to include six (6) 30-min web-delivered talks given by the leading experts in Additive Manufacturing. The entire webinar will last about 3.5 hours – 3 hours for the six talks and 30 min for switching of speakers and up to 2 questions for each presentation.
The webinars will start at 7:30 AM US EST (New York) to accommodate the different time zones of the globe.

The moderator is Prof. Sadhan Jana (University of Akron).

Six confirmed speakers are: Prof. Miko Cakmak (Purdue University), Prof. Tim Osswald (University of Wisconsin), Dr. Manfred Schmid (Inspire AG), Prof. Jae-Won Choi (University of Akron), Prof. Clemens Holzer (University of Leoben), and Prof. Jean-François Agassant (Mines Paris Tech).

This webinar is promoted to current and past members of PPS as well as to researchers in our profession.

Allen Press (which is also in charge of the memberships) will manage the registrations.
PPS member: $35
PPS member plus membership renewal: $145
Non-member: $70
Non-member plus one-year PPS membership: $145
Student: $35

PPS-36 International Conference, September 26-30, 2021, in Montreal, Canada

The PPS-36 International Conference of PPS will take place in Montreal, Canada, on September 26-30 2021 (website **http://www.pps36.ca/**). The venue will be the Bonaventure Hotel in downtown Montreal. The PPS-36 Organizers, Prof. Abdellah Ajji of Ecole Polytechnique de Montreal and his team, are making every effort to have a very successful conference despite the COVID-19 that postponed the 2020 Conference.
The dates for abstracts submission (or update) and registration will be as follows:
Initial abstract submission (or update of already submitted abstract): April 30, 2021.
Registration: early bird - up to June 30, 2021; regular: July 1 - August 25, 2021; late : August 26 - September 25, Onsite: September 26-30.
Hotel reservations (245 CDN$/night for single or double room): up to August 27, 2021.
The Organizers sincerely hope to see you all in the PPS-36 in Montreal, during the majestic fall mosaic of colors at that time.

Montreal is the second most populous city in Canada in the province of Quebec. The PPS-36 International Conference will take place there.

Montreal has a beautiful river front on the St-Laurent river near the city center.

Another view of Montreal's river front.

A Personal Perspective on Polymer Recycling: Challenges and Possible Solutions

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Until recently, not a day has gone by without a negative story about plastics appearing on newspapers, television, and social media. Images of various plastic items harming wildlife or pieces of trash bags polluting pristine beaches have resulted in a worldwide call to end plastic pollution. Nevertheless, the rapid spread of COVID-19 and the current public health crisis has made it abundantly clear that we need large supplies of cheap personal protective equipment, testing kits, and other life-saving medical devices, many of which are polymer-based.

The plastic waste problem is real: plastic waste, mainly single-use plastic bags and packaging, piling up in the seas and oceans and creating actual islands (sometimes called the "fifth continent"), has been a mounting challenge given the lengthy cycle of plastic degradation. Plastic microparticles may also seep into the food chain, pollute our water supply, and harm a number of marine species.

The outcry regarding excessive plastic usage has been heard loud and clear by our elected officials and the general public. However, indiscriminate damnation of plastics is often carried out without realizing all the benefits that several decades of research and development in the polymer industry have brought to humanity. In fact, the plastics industry has been a victim of its own success. Simply put, most plastic products are too cheap and last a bit too long. These qualities have made them the material of choice for use in large quantities worldwide, thus creating large mountains or floating islands of plastic waste.

A careful review of plastic usage indeed indicates that plastics have improved our lives in more ways than we can count. Some of the most compelling cases for plastic usage are as follows:

- The density of plastics is six times lower than that of steel and two and a half times lower than that of glass or aluminum. Imagine the weight of our cars, the resulting overconsumption of energy, or the wear of road pavements that would imply coming back to an "all metal" car design!
- A similar argument can be made for air travel. The use of polymer-based composites has considerably reduced the weight of modern passenger jets such as the Boeing 787 or the Airbus A350, resulting in up to a 30% reduction in jet fuel consumption.
- Imagine going back to metal household appliances and many consumer products! Imagine the excess energy consumption and pollution due to the extra weight of glass or metal packaging for mineral water and soft drinks!

- Plastic electrical insulation has not found a substitute for the insulation of electrical cables and connectors for industrial and household applications.
- The low thermal conductivity of plastics is quite important for commercial and residential buildings. There are alternative solutions, e.g., glass wool, but they require very thick walls to achieve the same insulation quality, and their insulation quality disappears when wet.
- Plastics long-term durability and corrosion resistance, coupled with their light weight, make them superior to alternative metal or cement pipes. Both transportation and installation of plastic water supply, sanitation, and gas supply lines are much more cost-effective and save considerable natural resources/energy.
- Plastics use in clothing, often in combination with natural fibers, allows for light, insulating, and shimmering clothing. Synthetic fibers certainly provide unmatched protection at a reasonable cost to large populations in extremely cold weather, thus promoting healthy living.
- Plastics use in packaging -which is often decried, and rightfully so, given the many examples of unnecessary "over-packaging" or single-use packages- allows the preservation of foods that otherwise could not be easily sold in supermarkets. New regulations that ban “single-use plastic products” will especially impact food packaging and may lead to considerable food loss and to drastic changes in consumption habits.
- Of course, there are other crucial applications in the biomedical field such as heart valves, coronary artery bypass grafts, artificial ligaments, and other ones, which are still embryonic but promising, in the field of neuroscience.
- We have discovered the importance of having access to single-use plastic personal protection equipment (PPE) during this scary COVID-19 pandemic. The already terrible public health crisis would have been even worse if we did not have cheap single-use PPE such as gloves, protective gowns, face masks, and plastic sampling swaps for wide-scale COVID testing.

Despite their many positive effects, the negative sentiment regarding plastics sometimes turns into all-out bashing without much merit or rational justification. Some of the recently proposed bans of PVC usage in window frames may, in fact, create a bigger problem. The aging of PVC due to long-term exposure to UV radiation and weathering has been solved for thirty years. Moreover, replacing PVC with the 2.5 times heavier aluminum would create disastrous "thermal bridges" with outside weather due to aluminum’s hundred times higher thermal conductivity. Clearly, wide-scale use of aluminum window frames would result in excessive energy losses! Other alternatives would not be durable or cost-effective. For example, wooden frames need to be repainted frequently to prevent them from gorging and rotting. Moreover, commonly used paints are not necessarily bio-based and entirely benign.

So we have to seek reasonable, common-sense solutions based on scientific principles and objective data. Could widespread **recycling** be the magic solution society is looking for? But here, too, one must be wary of overly simplistic solutions. For example, the idea of “recycling 100% of plastics” is not only unrealistic but could also create confusion among the public and delay the adoption of sensible solutions.

When talking about recycling, one must distinguish between two separate issues. First, the recycling of industry waste such as injection cores and non-compliant parts, for which effective recycling solutions have been well established in many plastic converter companies and, more generally, by the plastics processing industry. The second issue is the recycling of consumer waste. Here, it is also necessary to distinguish between high-value products for long-term use and cheaper consumer products for short-term use. High-value products for long-term use include cars and trucks, household appliances, and some of the plastic parts used in civil engineering for which chain stores and waste management and scrap companies set up recovery, dismantling, and sorting of plastic components. However, recycling is still mostly embryonic

for much shorter-lived consumer products, except for some well-defined cases such as PET bottles. Unfortunately, the problem is generally not solved but rather shifted from the consumer to “somebody else,” which gets plastics mostly into burning for generating energy. Yet, large-scale burning plants are expensive to build and maintain, especially without the steady and reliable supply of plastic waste. Moreover, without modern filters, sophisticated scrubbers, and strict regulation, incinerators may release large amounts of greenhouse gases, adding to environmental pollution.

For long-life plastic products, the approach could be to progressively produce parts with degraded functionality or to adapt the shaping process to incorporate recycled plastics. For example, designing a new car bumper using a significant amount of polypropylene from recycled bumpers will not significantly degrade the mechanical properties, but traces of bitumen or engine oil, which cannot be eliminated during disassembling and grinding, will gradually alter the appearance and the paintability of these new bumpers. On the other hand, modifying the appearance will not be a hindrance for "wheel arches" made from these remilled materials. An alternative is to modify the shaping process by using co-injection, which makes it possible to coat a recycled material core with a virgin skin material. This material would give the car bumper an external appearance identical to that of a bumper made entirely of virgin material. But this production process would be more expensive and, for time being, the price of recycled polymer is not necessarily lower than the price of virgin polymer. But another question is: how many times can you do this?

For short-term use consumer goods, recycling requires education, policy, and regulatory measures as well as research. The gradual disappearance of plastic bags in supermarkets is beneficial, but the recycling of other polyethylene plastic films (e.g., garbage bags, agricultural films, and wrapping films) remains a challenge because they are not as clean, and their grinding to obtain reusable flakes is difficult. Some specialized recycling units for agricultural films have been developed recently in France. Last but not least, polyethylene has a heating value equivalent to that of fuel oil and can be an effective oxidizer of household waste in incineration plants that are known to be able to eliminate toxic discharge.

Recycling is first and foremost a matter of education: sorting out waste is a form of civic duty, and children, from an early age, could be the best advocates for promoting selective sorting in their households. It is still necessary for sorting to be simple and easy to follow. Using too many sorting bins with confusing labels could reduce the amount of recycled material collected. Despite several years of education and recycling programs, plastic waste, cardboard packaging, and scrap metal (e.g., tins, cans) are still not collected separately in most countries.

It is clear that we have a long road ahead toward achieving a much higher rate of recycling. In fact, advances in recycling requires the following strong policy measures.

- It is necessary to establish effective networks of collection and sorting of plastic wastes, which can only be implemented by local authorities of significant size (several hundred thousand inhabitants). Although this has existed for decades for glass and paper, it is more difficult for plastics because of the different types of waste produced such as polyester bottles, polyethylene or polypropylene containers, polystyrene yogurt pots, and PVC packaging, among others.
- On the other hand, we should first tackle the issues that cause the most problems, i.e., the plastics value chain. Innovative product designs that are easy to disassemble would promote recycling. Designs that use fewer parts or different polymers would make it easier to sort, collect, and recycle. Packaging designed only for consumer appeal without any functionality should be discouraged.
- Recycled materials must be cost-competitive with virgin materials. In many cases, this could be achieved by delivering the sorted materials at a negative cost to the recycling plants. Recycling could further be promoted by regulating the use of landfills and

incineration. If the cost of using landfills and incineration is higher, then recycling would be a more attractive and cost-effective solution. At present, several EU countries including Germany, Austria, Denmark, and the Netherlands have banned the use of landfills for untreated waste.

- Last but not least, better standards need to be established that would allow, for example, some of these recycled polymer products to be used in food packaging applications.

Unfortunately, there is no magic bullet to solve all these issues. Recycling polymers remains a difficult business with a low profit margin because

- even sorted, it is difficult to return to the monomer/molecular state as can be done for metal or glass. The thermoplastic polymers can be remelted and granulated, but the quality of the resulting product is dependent on all the impurities (organic, mineral) that are difficult to eliminate without using chemical solvents or heating at a temperature far higher than the degradation temperature. These remaining impurities and pollutants can affect the thermomechanical and optical properties and severely degrade the functionality of the new part. Depolymerization is possible for polymers made by polycondensation. Much work has been done in the case of PET, a polymer for which the raw material is both easily sortable and homogeneous, but the solutions remain expensive, sometimes polluting and requiring energy consumption. Recently, the controlled degradation processes of polystyrene scraps have allowed recovering the styrene monomer.
- they are often combined with one another or with other materials. The milk bricks consist of an aluminum core surrounded by cardboard and plastics, and many plastic packages are, in fact, made of a stack of several different polymers, each one playing a specific role. Organoleptic properties for the surface in contact with the food, barriers to the diffusion of gases, mechanical strength, and printability are examples of such cases. Most of the time, these different constituents are not separable, and the grinding of these multi-layered or multi-material objects leads to incompatible mixtures with deficient properties that must be remedied through the incorporation of suitable compatibilizers at a reasonable cost. For example, we know of the harmful influence of a small proportion of polypropylene (cups) in a deposit of polyethylene containers. This represents a major challenge considering, for example, the production of 200 billion liquid bricks per year only for the Tetra Pak Company!
- the plastic waste, even sorted, in essence has a high level of inherent variability, which necessitates developing polymer processing methods that are successfully able to deal with this variability, including variations in viscosity and degradation temperature. Currently, however, there are effective solutions where a large proportion of recycled PET bottles can be utilized in the manufacture of new bottles or synthetic fibers used in clothing. But the question of what to do with these PET clothes after use remains!

A solution that has not been really investigated to date is to produce oxidizer briquettes from polymer deposits that are difficult to sort out and that could be used in incineration plants and cement plants. In the same way, PET may be also pyrolyzed to produce aromatic or aliphatic energetic compounds, but their cost needs to be competitive.

To overcome these difficulties, innovative research is required in the following key areas:

- The synthesis of new and multifunctional polymers that can combine several properties (e.g., mechanical, optical, barrier). This will reduce the number of layers in packaging, thus decreasing the processing cost and facilitating recycling.
- The decontamination process of packages, especially PET bottles, which would eventually allow their reuse in the food packaging industry and similar applications.
- The development of reliable depolymerization processes with low levels of pollutant emissions, resulting in oligomers with narrow mass distributions. One can thus dream of recycling methods being as effective as those for glass or metals. Sadly, these depolymerization processes can only be envisaged for a limited number of polymers.

- The realization of nanoscale mixtures such that the dispersed minor phase will have no or minimal adverse effects on the optical properties of the part and will even develop enhanced thermomechanical properties due to favorable synergistic interactions.
- A renewed development of reactive extrusion, which was very popular at the end of the last century, to cleverly combine the dispersion of the minor phase(s) and the introduction of the compatibilizer at the right place along the twin screw extruder, avoiding problems of coalescence.
- The development of processes adapted to these recycled polymers, sometimes coming back to ancestral technologies like compression, which make it possible to limit the dissipation of energy and, consequently, the problems of degradation.

An alternative to recycling is the development of **biodegradable polymers**, especially in packaging. The development of Polylactic acid (PLA) and its derivatives is now well established, but biodegradation requires specific pressure and temperature conditions that are not generally achieved in most existing waste treatment plants.

Despite considerable research on plastics recycling, the recycling of composites, particularly those reinforced with glass or carbon fibers, has lagged behind.

We must first realize that composites are generally composed of a thermoset matrix that cannot be remelted. Moreover, thermosets are mostly epoxy-based bisphenol A and PU based on highly toxic chemicals that can only be burned after use. Solutions to overcome this obstacle are being explored today. Possible solutions involve using physical rather than chemical crosslinks that can be destroyed by raising the temperature and increasing the use of thermoplastic matrices resistant to high temperatures.

Additional challenges for composites exist because the reinforcing fibers (glass, carbon, or bio-based) will be greatly degraded during grinding. These recycled materials can, at best, be reused as "short fiber composites" for very different applications than those of the original products.
The advantage of composites is, on the one hand, that the volumes to be recycled are of an order of magnitude lower than the volumes of polymers and, on the other hand, that the source of deposits is more easily identifiable: aerospace, automobiles (still modest), yachting, home appliances, and sports. Otherwise, repair methods for composites are being developed/improved that would extend their life and reduce the composite waste.

Concluding Remarks
Fifty years ago, the world was fascinated by “magic plastics.” Yet, during the last decade, the world woke up to the increasing dangers of plastic pollution and the mounting environmental problems. It is only now that we are beginning to understand that there are cures for plastic pollution without having to abandon a material that offers many benefits to society. New and sustainable plastic technologies can offer solutions where plastics can play a vital part of our lives without harming our health and the environment. Participating in the development of such solutions is a **challenge for the Polymer Processing Society** that we must accept.

Call for Nominations

2021 Fellow Awards of the Polymer Processing Society

(deadline December 31, 2020)

After more than 34 years of its inception, the Polymer Processing Society is recognizing its members as PPS Fellows for achieving distinguished record in scientific and technological developments in polymer processing.
Each year, up to 3 Fellows will be elected, preferably one each from each geographical areas - Americas, Europe and Africa, and Asia and Australasia.

PPS is now accepting nominations for its second group of Fellows.
Nomination process: A PPS member in good standing of membership will qualify for nomination as Fellows. A nomination package should include the following documents:

- Nomination letter (max 2 pages) describing the nominees scientific achievements and/or innovations in the field of polymers
- Statement of record of service to PPS (1 page)
- Complete CV
- Two additional letters endorsing the achievements listed in the nomination letter
- The nominator should be a member of PPS. Newly inducted Fellows will be recognized at the annual meeting of PPS

The nomination package should be submitted to:
Fellows Election Committee Chair
Prof. Sadhan C. Jana at janas@uakron.edu by **December 31, 2020**.

Call for Nominations

2020 Annual Awards of the Polymer Processing Society

(deadline December 31, 2020)

Nominations are now being solicited for three prestigious annual awards of the Polymer Processing Society (PPS).

The Morand Lambla Award honors originality, high achievement, and potential for continuing creativity among young researchers in the science and technology of polymer processing related areas. Candidates can come from any part of the world and may currently be working in academic, governmental, or industrial positions. Candidates need to be 45 years or younger by December 31st of the current year and do not have to be PPS members.

More information and details on the nomination process can be found under the awards section of the **Polymer Processing Society website.**

The James L. White Innovation Award honors outstanding researcher(s) or inventor(s) from both academia and industry, either as individuals or as a group, in the areas of polymer processing and related fields. The award is given for an innovative development in the field of polymer processing technologies with recent commercial impact. It aims to recognize originality, innovation, and creativity among researcher(s) or inventor(s) in the science and technology of processing polymers and polymeric products. Candidates may come from any part of the world, but must either be PPS members or should have participated in recent activities of PPS. They may currently be working in industry, governmental, or academic institutions or have retired.

More information and details on the nomination process can be found under the awards section of the **Polymer Processing Society website.**

The PPS Early Career Award recognizes productivity of early career researchers in the field of polymer processing as judged from the publications, patents, and the service to the Polymer Processing Society. Nominees may include tenured/tenure-track faculty members, post-doctoral researchers, and researchers working in industry or national laboratories as long as their Ph.D. degree was received within 8 years at the time of nomination.

More information and details on the nomination process can be found under the awards section of the **Polymer Processing Society website.**

Complete nomination packages for each of the awards should be sent by the first nominator before **December 31st midnight**, GMT in electronic format to PPS Award Committee Chair Prof. Ica Manas-Zloczower at **ixm@case.edu**.

Encouraging Young Researchers to participate in PPS-36, Montreal, Canada, September 26-30, 2021

Polymer Processing Society Graduate Travel Award AWARD Announcement (deadline January 10, 2021)

The Polymer Processing Society is proud to announce awards meant to encourage and financially assist young researchers working in polymer processing research programs to attend and present a paper at the Polymer Processing Society International Conference.

Polymer Processing Society Graduate Travel Award

For up to three graduate students, preferably PhD students, with research area related to the society's scope.

Eligibility:

• Graduate student from various institutions around the world, who will be attending and presenting at the Polymer Processing Society Annual Meeting.

• At least one year into a graduate degree program and working on polymer processing related research

Polymer Processing Society Young Researcher Travel Award

For up to two young researchers who have completed his/her PhD within 6 years of April 30, 2021.

Eligibility:

• A young researcher from various institutions around the world, who will be attending and presenting at the Polymer Processing Society Annual Meeting.

• Must be within 6 years of PhD graduation date

Fields of Study:

Polymer Engineering and Science, Chemistry or Chemical Engineering, Materials Engineering and Science, Physics, Mechanical Engineering, and related fields to Polymer Processing

Value: Up to $1,500 for each awardee to travel to the Annual Meeting of the Polymer Processing Society

Application:

•**Research accomplishments (CV required)**

•Research abstract of paper to be presented at PPS **(abstract required)**

•Support letter from supervisor **(letter from supervisor required indicating their endorsement and that they will cover any additional expenses over award amount to allow the student to travel to the conference with all normal expenses paid)**

•Academic merit **(post-secondary transcripts required—may be scanned)**

Please send to Prof. U. Sundararaj, University of Calgary via **pps-award@ucalgary.ca**

Deadline: January 10, 2021

APPENDIX
Your International Representatives

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Next Newsletter – April 2021

If you have comments on how to improve this newsletter or want to share some information in the next one, please contact the Newsletter Editor Prof. Evan Mitsoulis at mitsouli@metal.ntua.gr. The next issue of the Newsletter is due in April 2021.