

Research Internship Report

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1. Outline

[Host Company] Zeon Corporation, R&D Center, Specialty Plastics Laboratory

[Date] Sep. 23rd, 2020 – Dec. 18th, 2020

[Internship Theme] Research and Development on Cycloolefin Polymer Products

2. Motivation

Zeon Corporation is a chemical manufacturer which has the comprehensive utilization of C₄ and C₅ fractions of naphtha as core technology and supplies various materials such as synthetic rubbers and specialty plastics. The motivations for the internship at Zeon Corporation are as follows.

- (1) To know the process of developing new products in the corporate R&D center
- (2) To acquire new skills which cannot be learned at university through experiments handling a large amount of resin
- (3) To think about my own career plan through the internship at a chemical manufacturer

To satisfy these motivations, I chose the theme related to molding and evaluating physical properties which is relatively close to applied research.

3. Detail of Internship

In this internship program, I conducted research and development on cycloolefin polymers (COP) which ZEON started to produce and sell in 1990 for the first time in the world.

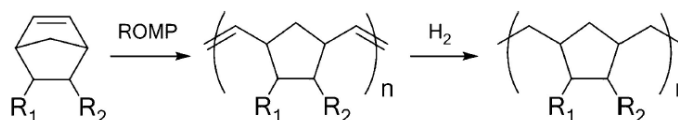


Fig. 1 The process of synthesizing COPs [1]

COP is defined as a polyolefin which has cyclopentane rings and ethylene alternately in the main chain and synthesized by ring-opening metathesis polymerization of norbornene (NB) derivatives and hydrogenation (Fig. 1) [1, 2]. It is possible to control various physical properties such as the glass transition temperature (T_g) by choosing substituents R₁ and R₂ of NB-based monomers and adjusting copolymer composition. COP is a thermoplastic resin which satisfies the characteristics required for optical resins in well balance such as transparency, low birefringence, moisture resistance, chemical resistance, heat resistance, precise moldability and impact resistance. Therefore, COPs are used for optical products such as optical lenses and prisms. Furthermore, COPs are also applied to medical products such as syringes and vials because COPs exhibit such properties as low impurities, low water absorption, and low adsorption.

During the internship program, I prepared COP pellets under various conditions which had never been tried and evaluated their physical properties with the aim of developing new products of COPs. The series of the experiment was as follows. First, I prepared various types of COP pellets by twin screw extruder under various molding conditions. Then, I obtained test pieces such as dumbbells and flat plates by injection molding and evaluated thermal properties (T_g , oxidation starting temperature), melt properties (MFR), mechanical properties (flexural modulus / strength and tensile modulus / strength / elongation) and optical properties (light transmittance, haze and ΔYI) and so on. I could summarize the correlation between sample conditions and their

various physical properties, which will be a guideline of future research and development. On the final day of the internship, I performed the presentation in the Specialty Plastics Laboratory.

[1] Yamazaki, M. *J. Mol. Catal. A Chem.* **2004**, *213* (1), 81–87.

[2] Harauchi, Y.; Houkawa, T.; Adachi, S.; Arai, K.; Sawaguchi, T.; Hayano, S.; Uchiyama, S. *Kobunshi Ronbunshu* **2018**, *75* (6), 477–485.

4. My Impressions

Through this internship, I achieved all the three objectives. In particular, I was able to know various differences between corporate R&D and research in university laboratories.

First of all, I felt that corporate R&D places high importance on customer needs and changes in society in setting research themes. In addition, they make much effort on solving problems occurring in plants to improve production efficiency. I realized that a chemical company conducts R&D to gain future profits.

The scale of the experiments was also different from those of the lab in the university. I was surprised that a large amount of resin (ex. 20 kg of pellets) is used even at the research and development stage because polymers are used in units of gram at most in our lab. In addition, the series of experiments including twin screw extruder, injection molding and evaluating the physical properties of a large amount of resin was my first experience, and I could acquire new knowledge and skills.

I also felt that safety is very important in corporate R&D center. There are many experiments which may lead to accidents. Researchers in Zeon made efforts to prevent accidents in advance by predicting dangers before experiments, keeping laboratories tidy and so on. Since I realized that there are many safety issues in our lab through this internship, I want to continue to improve experiment environment for more safety.

As mentioned above, this internship at Zeon for three months gave me an image of working in corporate R&D center, which was a valuable experience for me to think about my own career plan. I can recommend internship programs in companies to not only those who want to get a job at a company but also academia-oriented students to learn about the research and development of a company.

5. Acknowledgments

I sincerely appreciate ZEON Corporation for accepting me as an internship student for three months despite COVID-19. In particular, Mr. Takashi Houkawa, Mr. Taichi Sawaguchi and those in Specialty Plastics Laboratory provided many supports such as setting the internship theme, OJT of various experimental apparatus and discussions on experimental results. In addition, those in the Research Planning and Management Department kindly reserved accommodation, prepared necessary items and settled expenses and so on. I would like to express my gratitude to all of them who support my internship program.

I appreciate Ms. Aoki (GMSI program) and Prof. Yoshie (Dept. of Chemical System Engineering) for their great supports in applying for the internship. In addition, Prof. Yokoyama and the staff in Ito & Yokoyama laboratory and Prof. Noji, who is my secondary supervisor of MERIT program, kindly admitted my internship program. I am grateful to them.

Finally, I appreciate those involved in MERIT program for giving me a valuable opportunity to broaden my horizons through the long-term internship.