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PLASTICS ENGINEERS
Upper Midwest Section
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Newsletter

November 2016

Upper Midwest Section Board of Directors 2015 - 2016

CALENDAR OF EVENTS

FALL MEGATECH ..... November 15, 2016

AWARDS GALA .....February, 2017

ANTEC .....May 8-10, 2017

Upper Midwest Section
(S22) Membership
June, 2016
Section Total 309

Society of Plastics Engineers • Upper Midwest Section

November 2016 • *Volume 42*

THE SPECIALIST

FALL MEGATECH

DRYING OF POLYMER RESINS: THE CRITICAL VARIABLES TO KNOW FOR BEST RESULTS

Tuesday, November 15th, 2016, 8:00 am - 5:00 pm
Hennepin Technical College - Main Auditorium
9000 Brooklyn Blvd, Brooklyn Park, MN 55455

Our products are only as good as the raw materials that are fed into extruder. When the feedstock contains too much water, we will get unpredictable products, degraded molecular weight, and in some cases large bubbles in the extrudate. But drying adds an extra processing step, and maybe slows down the production rate. Other times, a lot of effort and skill must be used to measure moisture levels and assure ourselves that the feedstock is ready to be extruded / molded.

This Megatech will present the latest in drying, desiccant and moisture measurement technologies. The attendee will be presented with the best, most time-saving methods for assuring an adequate level of dryness without costing a lot of money.

Knowledgeable Speakers from:

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	Register Before November 10th	Register After November 10th
SPE Members	$150	$175
Non-SPE Members*	$200	$225
Students**	$25	$50

*Please join SPE and help support the plastics industry and get better pricing
**Covers the cost of breaks / meals

***MEGATECH** continued on page 2*

MEGATECH *continued from cover*

Sponsorship Opportunities –

Go to www,uppermidwestspe.org/upcoming-events.html to register as a sponsor

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Platinum Sponsorship - $650.00
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- Company name/Logo on all fliers sent out, e-blasts and communication about event.

*** SPE is a non-profit organization and money goes towards scholarships for students in plastic programs. SPE also strives to bring valuable Mini-Techs and Mega-Techs that help keep the Upper Midwest Plastics competitive and on the cutting edge of technology. SPE and the Sponsors are committed to supporting students and the future of our local plastics industry.

Who Will Be Our Next Plastics Hall of Fame Winner?

Dick Bopp, Awards Chair

As we rapidly speed through the fall season, it's time for us to ponder this weighty question. So, I am calling on each of you to please take a moment to think of those individuals in the Upper Midwest Section who have over the course of their career contributed significantly to the plastics industry. Their contribution may have been in technology, business, academia, service or any combination. You can find the guidelines for the Hall of Fame award listed in the box below. I firmly believe that recognition by one's peers is the highest praise possible. This is our opportunity to bestow such an honor on a highly deserving local man or woman. Please send your nominations to me at rcbopp@mhcable.com. We appreciate receiving as much relevant information as possible. But, even a single paragraph will do to help get the vetting process started. Please don't hesitate to contact me directly, if you have any questions. In addition to email, I can be reached at (612) 845-0722 by phone or text. Nominations close on November 15, 2016. The award will be presented at our Awards Gala which will be scheduled in late January or early February. Many thanks in advance for your help!

Nomination Guidelines –
Upper Midwest SPE Section Hall of Fame Award

Nominee's Qualifications must include:
1. Active member of SPE for 10 years minimum
2. Member of Upper Midwest Section for 6 years minimum
3. Shall be sponsored, in writing, by at least one current Board member of the Upper Midwest Section
4. Shall have demonstrated long-term, outstanding service to and support of the Society and its objectives

Nominee's Qualifications should include one or more of the following criteria:
1. A significant scientific/engineering/equipment invention or breakthrough
2. Development of an outstanding product / market / end-use niche, or business endeavor
3. Long and valuable service to a segment / constituency / discipline / association / etc. of the plastics industry
4. A record of constructive, collaborative action with government / regulatory / academic / environmental / health / trade / or other industry-related groups

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SPE Education Committee – *Tom McNamara*

After providing 5 scholarships last Spring to very worthy students at UW-Stout, Winona State University, and Hennepin Technical College, your Upper Midwest Section has once again approved funding for scholarships this Fall. These scholarships will go to both 2-year and 4-year full time students in a plastics field of study. The 2-year students should apply for the Tony Norris scholarship award while the 4-year degree students should apply for the Jerome Formo scholarship award. Please check the Upper Midwest Section website for requirements and application links.
In other news, SPI has extended their program to fund student membership fees to join or renew with SPE. Students participating will receive a free SPE student membership and also an electronic membership to the Society of the Plastics Industry (SPI). Students who are US citizens with primary residency in the US receive their complimentary membership by simply joining or renewing online. Just go to www.4spe.org and follow the membership instructions. All during the registration it will look like you will be charged $31. However, at the end there will be a check box asking if you want SPI to pay the registration fee. If you check that box, the billing amount should zero. If you have a problem, contact membership services at SPE.

COUNCILORS CORNER CONTINUED
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ANTEC Redesign for Success (Babli Kapur)

The goal of this effort is to deliver a redesign plan at the end of 2017 for presentation at ANTEC 2018 through a core team of volunteer councilors and past TPC"s (technical program chairs).

The root causes for decline in ANTEC attendance were reported as multifaced, but it's thought that conference papers have begun to lose some luster in terms of their perceived ability to contribute to authors' professional development. This in turn has led to an overall diminishment of the quantity and quality of ANTEC papers. And yet, ANTEC still has many important attributes as the major annual international technical conference for the plastics industry, e.g., breadth and depth of overall plastics technology presented, unique bridge between academia and industry, global reach and historical presence.

Some excellent ideas about redesigning the ANTEC format were presented, including focusing on quality vs. quantity, emphasizing new & emerging topics, organizing by topic rather than by Division, featuring more invited academic & industrial speakers, offering technical skill development sessions extended across the entire supply chain, focusing on organizational networking opportunities, e.g., career fairs, consulting clearinghouse, integrating plant field trips, offering STEM educational events, and partnering with other associations & societies. I'm sure you will agree each of these represents a promising idea for positive change. The critical need for the future success of ANTEC, however, will be to limit the development and implementation to just a few of the most promising ones. Donna Davis' team has shown that they are on a good track to do so in time for ANTEC 2018.

Not all our attention was focused on the future. We also took some solemn moments to remember two SPE luminaries who had recently passed. Heartfelt eulogies were given for Dr. Nelson Wright and Mr. Mike Tolinski. Details of their many contributions to the plastics industry and our Society can be found in the October issue of *Plastics Engineering.*

The needs of our membership and the plastics industry are changing rapidly. Clearly, we will need to adjust to these changes or risk becoming irrelevant. I am heartened to see so many talented and hard working volunteers, including our Section's board members, putting their shoulders to the task. Please contact Shilpa, me or any board member if you'd like to join in. As always, your help will be greatly appreciated. Our contact information is listed in detail on the back page of this newsletter. Many thanks!

President's Remarks *Shilpa Manjure*

Greetings to all members!

Hope everyone had a fabulous summer. We were happy to see some of you at our Annual Golf Outing and have a great time at Oak Marsh again. Sunshine blessed us and there was a slight wind to cool us off. Eric Swensied, our Special Events Chair, had organized an interesting raffle and there were several prizes to take home. Hoping to see more participants next year in early August!

In our summer SPEcialist, we had posted an advertisement regarding needing more volunteers on the board and I would like to make that pitch again – we still have several positions open on the board and would like to get fresh energy to keep the movement of SPE marching forward. Good news is we recently had Dr. Ajay Padsalgikar, Principal Scientist at St. Jude Medical, join the Upper Midwest Board of Directors. He will be taking up the role of Awards Co-Chair supporting Richard Bopp and Dave Erickson. Thank you Ajay for your time and commitment to SPE. Please read the Spotlight on the Board column in this newsletter to learn more about Ajay.

On the events front, we have received a tremendous response for our plant visit to Uponor scheduled in a few days (it might be completed by the time you receive this newsletter). We are thankful to Uponor for their support in opening the doors to their manufacturing facility. It is one of the ways in which SPE-UMW board strives to educate its membership. There is a reason why they say "a picture says more than a thousand words" and I would say, "an actual field visit and demo says more than thousand pictures". J

Our last event for the year is our MegaTech. This will be at the Hennepin Tech on November 15. We all have dealt with moisture sensitive materials at some point – nylons, PLAs, etc. The one-day seminar will cover basics of drying, comparison of different dryers, fundamentals and more. Hear it from the dryer manufacturers themselves!! Make sure you register asap and hold your spot.

In preparation for Awards Gala which is our first event for the year, our Awards committee has not only been working hard at putting together the logistics but would also like nominations from you. Dick Bopp, our Awards Chair is seeking your help in nominating for Hall of Fame for the Upper Midwest Section. He has summarized the qualifications needed to nominate an individual in this newsletter.

Finally, it is time for our Fall scholarships again. We would like to invite students in Plastics and related programs that are SPE members to apply for two scholarships we offer. The SPE-UMW have been giving out several scholarships over the past couple of years. You might be the next one – so take the time to visit http://www.uppermidwestspe.org/educational-links.html and APPLY TODAY or email Thomas McNamara, Education Chair, at Thomas.McNamara@thermotech.com.

Looking forward to seeing you at the MegaTech on November 15– our last event for the year.
Warm wishes for an enjoyable fall and holiday season to follow!!

Best Regards, Shilpa Manjure

POSITIONS WANTED ON THE BOARD

Open currently or Soon to be available

• Awards Co-Chair • Membership Co-Chair • House Chair
Other Board Directors for various sub-committees

Tenure: 1-2 years depending on position and sub-committee
Qualifications Needed: SPE member; part of the plastics industry;
enthusiastic, accountable, and passionate about plastics educations of the community

Contact: Shilpa Manjure (smanjure@ntic.com)

Councilor's Corner *by Dick Bopp*

It was my honor to serve as proxy for Tom McNamara at the Fall SPE Council Meeting this year which was held in Quebec City on August 19-21. Because I am now living in upstate New York, I had the added pleasure to use this occasion to make the very pleasant drive up I-87 through the Adirondack Mountains to the outskirts of Montreal and then turning northeast onto Route 20 falling the St. Lawrence River valley toward the capital of the Quebec Province of Canada, one of the oldest European cities in North America, established in 1608.

The 3-day meeting began Friday evening with a reception and a team building exercise where randomly assigned teams were tasked with building "pinewood derby-like" race cars, one constructed of post-consumer recycle plastic materials and the other "solar" powered. After a single-elimination contest, the fastest cars for each class were chosen giving much valued bragging rights to the winners. But, more importantly, the exercise helped breakdown the natural social barriers for the attendees. Then as a reminder of the strong commitment of SPE to education, each team put together kits for solar cars that were donated to the Quebec YMCA for their STEM (Science, Technology, Education and Math) program—an added bonus.

The business portion of the meeting followed on Saturday and Sunday. Scott Owens, President, gave an outline of the agenda. Of central importance was governance reform. Indeed the bulk of the meeting was focused upon changing SPE bylaws and policies to streamline the way we run the Society. Additionally, there were two special workshops given one on modifying ANTEC and the other on enhancing membership growth. Finally, there would be discussion of project updates, most notably Plastic Insight.

The Treasurer's report, given by Jeremy Dworshak, showed mixed results. There was a reported $165K YTD loss ascribed mostly to a shortfall in membership revenue. Cash on hand was reported at $322K at the end of July and expected to tighten somewhat through the fall until revenues for upcoming TOPCON's were received. On the other hand, expenses had been kept under control and well under budget. The current forecast for year end is that we will end up between $50K and $100K in the black. Clearly, these financials underscored the importance of our assigned tasks increasing membership and revenue..

Membership/Rebates

Regarding membership, we currently have 13,154 premium members paying $129/yr with about 1-2K students paying $25/yr. We also have a growing "e-membership" currently at 21,047 who pay no dues and have very limited access to SPE benefits. To increase membership and revenues, it was suggested that we might provide a limited free trial membership to our e-members so they could realize the benefit of being a full member. Then they would have the option to continue as a dues-paying member or to opt-out of full membership if they did not see the benefit. No decision was made to implement this idea, but I see it as an easy "no lose" option.

To better align our dues cost structure with those of other similar professional societies and to help meet our financial needs, a dues increase to $155/yr effective Jan. 1, 2017 was discussed and approved. This change alone is expected to provide additional $100K in 2017 and $200K in 2018. On the accounts payable side of the ledger, rebates to Sections and Divisions for 2016 will continue at $10 per premium member. Total payout of rebates for 2016 will amount to $96,794.

Governance Reform Task Force (GRTF)

The formation of an executive board comprised of 11 or 12 volunteer vice presidents with specific assigned responsibilities was formalized during this meeting. Each VP will provide oversight and direction to operations through their assigned committees—all decisions subject to Council, albeit indirectly. This was the central focus of the meeting. Here's a summary:

There will be a 3-year operating plan which is expected to provide for better long term planning. Term limits of executive board members, i.e., 3 years terms with the exception of presidents and 9-year lifetime term limits. Bylaws and policies will be streamlined, all requiring Council vote. (All passed with only minor modification.) Structural changes to bylaws and policies become effective at ANTEC 2017 in Anaheim, CA.

COUNCILOR'S CORNER *continued on page 10*

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Moisture Content	0.01%	0.03%	0.08%
Cavity1	2.77 MPa/s	3.15 MPa/s	3.40 MPa/s
Cavity2	2.96 MPa/s	3.17 MPa/s	3.46 MPa/s
Cavity3	2.54 MPa/s	2.78 MPa/s	2.99 MPa/s
Cavity4	2.65 MPa/s	2.86 MPa/s	3.14 MPa/s

Table 1: Average Viscosity Change of Individual Cavities

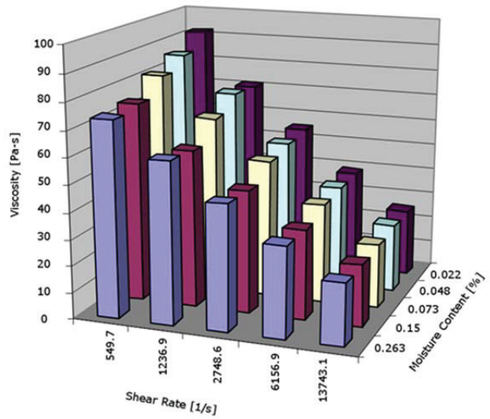

Diagram 3: Extended Measurement with Kayeness Rheometer

Moisture	0.01%	0.03%	0.08%
Cavity1	1.065	0.27	0.871
Cavity2	1.088	0.609	0.933
Cavity3	1.122	0.675	1.036
Cavity4	1.072	0.617	0.962
Average	1.087	0.543	0.951

Table 2: Standard Deviation shown on Cavity Pressure (Peak)

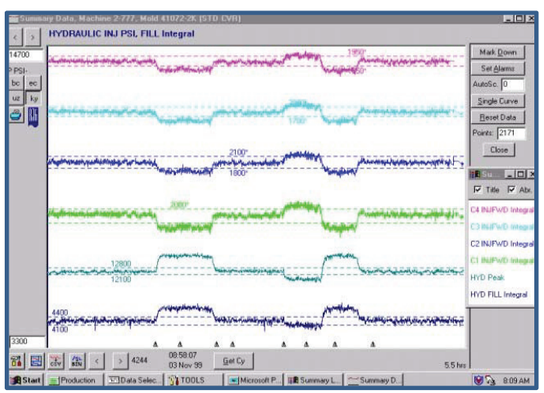

Diagram 4: Mold and Machine Data by Various Moisture Levels

This Science Corner Article was published in the Proceedings of ANTEC, 2000. The questions raised by these authors are real and common to many production engineers. These questiosn will be answered at our upcoming Megatech on November 15. Please attend! And please attend ANTEC 2017 in Anaheim.

SCIENCE CORNER

Drying: A Closer Look

Dipling (FH) Thomas Schwab, Siemens EC, John E. Pery, Siemens EC

Abstract

This paper will discuss the adverse effect on viscosity when polymers are excessively dried. Many processors are concerned exclusively with excessive moisture and give little consideration to the permanent detrimental effects from over-drying. As part size gets smaller in many applications, dryer throughput is lower. The result is extended exposure to the drying process. Thus, the viscosity of the material is increased and permanent loss of material properties occurs. This effect was observed as an actual manufacturing problem.

Background

Drying is at first glance an easy method. Material is pulled into a hopper. Dehumidified hot air is flowing between the plastic pellets. The air binds the moisture and transports it back into the desiccant bed. This approach hasn't improved much over the years. Tremendous advances have occurred on the shop floor with process control improvements where molding machines and auxiliaries are concerned. However, the process of drying the material has been somewhat overlooked and very often out of consideration as the root cause of process variation.

The problem of drying becomes more obvious when applied to the thin-wall design of molded parts. With the use of cavity pressure sensors, the slightest change in viscosity can be monitored. The variations caused by shortcomings of the drying process are now highly visible. The most common engineering materials, like PA, PET, PBT have polar groups inside the chemical chain structure. Those groups are responsible for the hygroscopic nature of the pellets.

The four things, which are important in the drying process, are:

- Temperature of the air
- Moisture content of the drying air
- Airflow
- Dwell time of the pellets in the hopper

The first three are well understood in the industry and most dryer designs are well developed in this area. The temperature is controlled by thermocouples and most are directly on the hopper. The moisture content of the air is kept constant. Dew point of the air should be –5 °C. Airflow is generally well calculated for the different sizes of dehumidifying drying systems

The fourth issue is much harder to control and to maintain. In many modern injection molding plants, central drying systems have taken over. Normally, multiple machines may draw from a common drying bin, e.g. six molding machines using the same material. Due to a production stop, three of the machines stop consuming. The result is that the hourly usage of the material is cut in half. No one is going to adjust the volume or the temperature of the dryer. The material residence time is now extended twice the recommendation of the resin supplier. This problem was observed in our plant. With an extended drying time of four to five hours, the rest of the machines had problems filling the cavities. The question was "Does over-drying affect the viscosity and how much is the real influence?"

Experimental Approach

Two different approaches were taken. The first was made in Germany at FH-Rosenheim. Preliminary tests were made using a Goetfert high-pressure capillary viscometer to check the viscosity of the material. Due to the age of the equipment and the test series we started to make additional measurements with newer and more reliable equipment. A Kayeness Rheometer from Dynisco Polymer determined the melt viscosity. A moisture analyzer was located immediately next to the test equipment, to ensure more accurate moisture measurements.

Practical Approach

After performing the two laboratory test series, the method was to show the problem in an actual process. The most sensitive way to demonstrate a problem is the use of cavity pressure technology. The material from the second laboratory test was used for the experiment. Material was dried at 0.01%, 0.03% and 0.08% moisture. The material supplier stated in his literature that the optimal moisture content is below 0.1%.

A four-cavity hot runner mold was used for the experiment. To show a better correlation between moisture and viscosity, machine and mold data were collected.

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SCIENCE CORNER continued from page 6

Test Results and Discussion

The first results have shown the connection between the drying parameters and a possible molding parameter. In the first test series, three different temperatures (270/280/290 C) and two different pressures (5 and 11 MPa)were used. The drying for this experiment was done in a press-side dehumidifying dryer. To minimize any adverse effects, the material was dried for four hours at 80 C. During the measurement the temperature was dropped to 50 °C. After the measurements the dryer was turned off for four hours to simulate a production interruption. Then the over-drying process started. The material was exposed to 70 C for 12 hours. The whole process duplicated an actual startup process as seen on the manufacturing floor.

The results from the first measurement are reflected in Diagram 1. It shows that with an increase of the temperature the viscosity is increased. This is similar to studies done before in the plastic industry. Nevertheless the effect of drying is shown in the y-direction. By extending the drying time the viscosity of the material is also increased. The effect is more obvious at lower temperatures. The overall range of the viscosity from wet to dry was between 4 and 14% .The range from dry to over-dry was from 12 to 89%.

Actual temperature and conditions used in the molding department influenced the second series. As mentioned earlier, the amount of data taken for the second one was by far more intensive than the first series. This time the temperature (275 °C) was held constant over the whole series to gain more data in this specific area. Nevertheless, the number of materials was increased. The samples were taken from a central drying system. The moisture was measured before the test and between every second sample, to ensure exact moisture content from the samples.

The results varied between the different materials. It wasn't possible to find a correlation between the different materials. Even so, the same phenomenon seen before was discovered again. The material, which is shown in Diagram2, is a PA66 35% glass filled. The viscosity is lower with an increased moisture level. The viscosity step inside the moldable range (from 0.022% to 0.075 %) is nearly as big as the step (from 0.075% to 0.263%) where the material is too wet for the molding process. In diagram 3 it is easier to see, how much the viscosity of the material really increases. The viscosity increase from the mean by extended drying was from 4% to 12%. A wet material showed viscosity loss from approximately the same range.

The outcome of the shop floor test showed equivalent data as seen before in the laboratory test series. Diagram 4 shows the summary curves of individual cavities, the hydraulic peak and the hydraulic pressure integral. The hydraulic pressure integral reflects viscosity. In the diagram it is easy to see the moment at which the material was changed to a higher or lower moisture level. All cavities have shown that the moisture decrease from0.08% to 0.03% results in a viscosity increase of 9%. Additional drying to a lower level (0.01%) increases the viscosity by another 10% .

A look at the hydraulic pressure as a machine parameter shows a similar result. From 0.08% to 0.03% moisture level the machine needed to increase the hydraulic pressure by 3%. On the other hand from 0.03% to 0.01% the increase had to be by 10% to fill the cavities.

A shift in the required hydraulic pressure is not by itself a problem for new closed loop machines driven by cavity pressure control, except for the increased range of variation from shot to shot. Table 2 demonstrates the standard deviation of cavity pressure and hydraulic pressure. It is obvious that in either a moisture increase or decrease, the viscosity from shot to shot is changing. Again it shows how great the impact of over-drying is. The change from 0.03% to 0.08% results in smaller variation than the change from 0.01% to 0.03% .

When considering process robustness, it is better to stay in the window between 0.03% and 0.08% ,thus having less variation in the process.

Conclusion

In the laboratory experiment, it was seen that over-drying had a greater negative influence on the viscosity of the material than if dried to the middle or higher moisture level, even when within the recommended range. In the shop-floor test, these results were confirmed. On one hand we know that excessive moisture affects the molder's control of the process. This is apparent on the parts and in the molding process– splay, flash, etc.

On the other hand, too little moisture is a problem, which is less easy to determine than excessive moisture. Often molders attempt to compensate by raising the melt temperature or the injection pressure to cover up the problem. Any need to change the machine settings are obviously less than ideal.

A solution for this problem isn't easy to find. A lot of the problem has to do with excess dryer capacity. If the hopper is too big compared to the usage of material, the drying time for material can be extended (as much as 24 hours or longer).Hopper sizes are normally specified to allow for future expansion by estimating future business. The supplier company adds a little bit to it. In the end is a

SCIENCE CORNER continued on page 7

SCIENCE CORNER continued from page 7

drying system, which is not fully utilized and does not meet the present need for appropriate drying.

In today's demanding injection-molding environment, it is increasingly difficult to maintain high part quality without constant viscosity conditions. There is therefore, a need for a precision drying system, where moisture level may be delivered to the molding process at a consistent prescribed level to ensure minimal process variation.

Acknowledgement

The authors wish to thank Prof. Dr. Schwarzer and Prof. Karlinger for their support during the beginning of the studies. They are grateful to Siemens EC for the permission to publish this paper.

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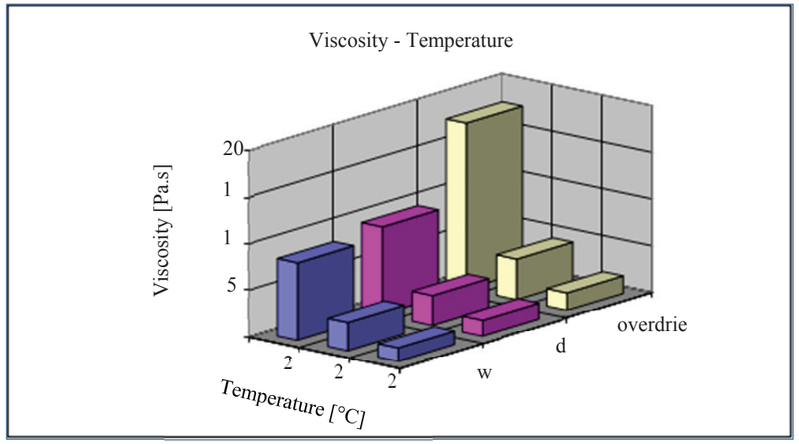

Diagram 1: Measurement of viscosity with the Gottfert Rheometer

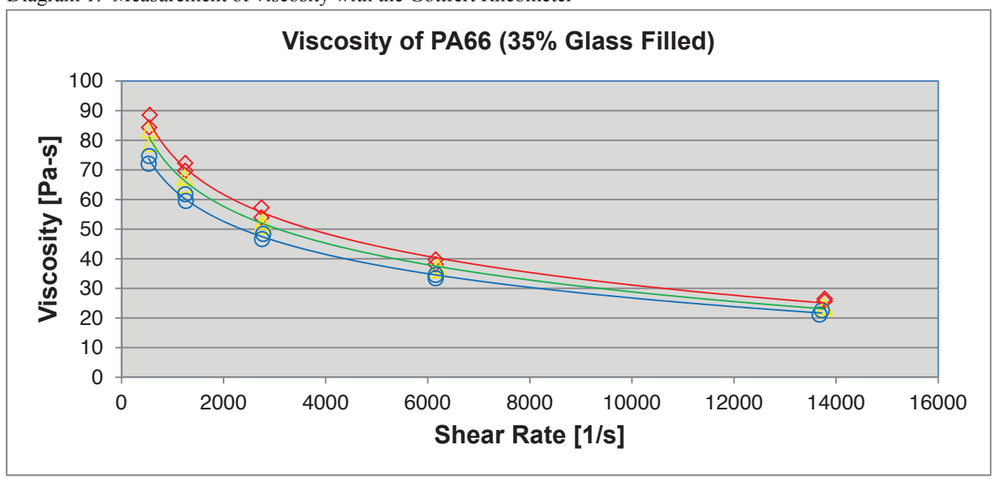

Diagram 2: Viscosity Measurements with Kayeness Rheometer

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