



**INTERNATIONAL CONFERENCE
ON EDUCATION, TECHNOLOGY, AND SCIENCE**

**Improving The Quality of Education
To Face The Impact of Technology**

University of Muhammadiyah Purwokerto

December 28th, 2013

P R O C E E D I N G S



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**International Conference on Education, Technology, and Science
NETS 2013**

Improving The Quality of Education to Face The Impact of Technology

PROCEEDINGS

**Universitas Muhammadiyah Purwokerto
Purwokerto, December 28th, 2013**

Preface
Rector of UMP

Assalamu'alaikum wr. wb.

Alhamdulillah, that UMP will carry out prestigious event namely "National Olympiad and International Conference on Education, Technology, and Science (NETS) 2013" is a very great news for me. NETS 2013 is the first event which is conducted in collaboration between UMP and PWM Central Java. It is a great event which is constructively supported by ITB, UNiSA, UTeM, and several institutions under UMP partnership to smoothen the event.

Recently, technology grows very fast. This fast growth affects on the quality of education in Indonesia. Based on this condition, UMP and PWM Central Java formulate a program which later it is formed into "NETS 2013". This event is also a contribution to Islamic Higher Education Institution to prepare candidate of future leaders who have competitive skills to compete positively in comprehending knowledge and technology.

In NETS 2013, there are some events which are arranged in a sequence such as: International Conference on Education, Technology, and Science (ICETS) with Prof. Dr. Ir. Imam Robandi, M.T., Mr. Ganjar Pranowo, Mr. Simen Lourds, and Dr. Hiroshi Takeda; Seminar (Call for Paper) including some disciplines of science covering Education, Engineering, Medicine, Science, Social, Politic, Religion, Law, Culture, Arts, Agriculture, and Technology; National Olympiad for Student and Teacher (NOST) which is joined by students, teachers, and schools; and Expo. In NETS 2013 competitions, participants are fighting over trophies, medals, certificates, and advisory fund reaching up to Rp250.000.000,- ; furthermore, there is also a fellowship to study in UMP.

As the Rector of The University of Muhammadiyah Purwokerto, I do really expect that conducting this event could encourage all of us to be more advanced nation not only on economic side, but also on social life. It is also expected that this event will increase our awareness on how important it is to develop and advance technology in education.

That is all I could deliver now, for further information you may access our website on www.ump.ac.id.

Last but not least, "Let's join and support NETS 2013 in UMP".

Wassalamu'alaikum wr. wb.

Purwokerto, 28th Decembe 2013

Rector,

Dr. H. Syamsuhadi Irsyad, M. H.

Preface

The Chairman of NETS 2013

Assalamualaikum, wr. wb.

Today is the valuable and precious milestones for education in Indonesia in general and Muhammadiyah in particular because all levels of education from elementary schools to university get together to build relationship and networking in the national Olympiad and international conference hosted by University of Muhammadiyah Purwokerto.

We deserve rejoice and pride because there are more than 1705 participants, 215 officials and 300 invited guests. This is also a great honour for University of Muhammadiyah Purwokerto to have the Governor of Central Java and the staffs, the regents from four regions and the staffs, the chief of Central Muhammadiyah Board , the Education division of Muhammadiyah Board, the directorate of higher education, Rectors of University of Muhammadiyah throughout Indonesia and rectors of universities in Purwokerto, companies and stake holders, media , travel biro as well as the colleagues, persistent fighters for Muhammadiyah in the region and territory.

As the chairman of this events, I'd like to report that there are more than 1616 teachers and students who will be joining the national Olympiad and there are more than 311 researchers, lecturers and students will be taking part in the International Conference. Again, I'd like to emphasis that this event is really a pride for us because the participants are coming representing five big islands in Indonesia, they are Sumatra, Kalimantan or Borneo, Java and Sulawesi.

This event holds thirty one types of competitions and organizing six international conferences. There are twenty five competitions for students, four competitions for teachers and three competitions for schools. The international conference covers fields of Educations, Engineering, Science and Agriculture, Health and Medicine, Culture and Arts, social, Politics, Economics, Religion and Law.

We are proud to mention that we have at least fifteen experts coming from higher education, one from high schools, two industries and one national research centre (LIPI). The experts and scholars are coming from some outstanding universities and institutes such as University of South Australia, Tottori University Japan, Institute Teknologi Melaka, Malaysia, Henderson Secondary School Singapore, Boromanjani College of Nursing Thailand, Surabaya Technology

EFFECTS OF TIME AND TEMPERATURE OF POLY ETHER ETHER KETONESULFONATION (sPEEK) ON THE SOLUBILITY OF sPEEK IN DIMETHYLACETAMIDE

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Abstract

This work aims at investigating the effects of time and temperature of PEEK sulfonation on the solubility of sulfonated PEEK (sPEEK) in the solvent of dimethylacetamide (DMAc), as a part of manufacturing Proton Exchange Membrane Fuel Cell. Using direct method, PEEK was sulfonated in high concentrations of sulfuric acid at temperature variations of 30, 50, and 70°C, for the period of times of 60, 90, and 120 minutes. Higher temperature and longer time of sulfonation resulted in finer size of sPEEK deposits. As predicted, the solubility tests showed that the finer sPEEK was dissolved better in DMAc.

Keywords: poly ether ether keton, sulfonation, solubility, dimethylacetamide

BACKGROUND

The dependence of energy on the fossil oil basis should now be reduced using alternative energy. Fuel cell is one of solutions of electrical energy sources with some advantages, i.e.: high energy efficiency (more than 60%), friendly environment, and can be applied in several applications. One of fuel cell types, Proton Exchange Membrane Fuel Cell (PEMFC), utilizes polymeric membrane as electrolyte material to transfer proton from anode to cathode. Today's, the commercial PEMFC uses Nafion; however, it is very costly. The utilization of cheaper material, as poly ether ether ketone (PEEK), is expected to be able to reduce the fuel cell manufacture cost. Since PEEK is a non-ionic material, it needs to be modified into ionic one hence having ability to conduct ions. The modification may be through sulfonation process or by adding other conductive materials. To be made into a non-porous homogeneous membrane, the sulfonated PEEK (sPEEK) must be dissolved in an appropriate

solvent before casting. In this case, the solubility of sPEEK in certain solvent becomes important parameter. In general, the recent work aims at modifying PEEK into an electrolyte polymer through sulfonation process. In the beginning step, the work investigates the ideal conditions of time and temperature of PEEK sulfonation reaction to obtain certain degree of sulfonation (DS), which eventually affects the degree of sPEEK solubility.

METHOD

The research design applies group random method. The measured responses are sPEEK solubility in DMAc. Tabel 1 shows an illustration of factor combination used in this work.

Tabel 1. Design of experiment

	<i>t</i> 1 (60)	<i>t</i> 2 (90)	<i>t</i> 3 (120)
T1 (30)	T ₃₀ t ₆₀	T ₃₀ t ₉₀	T ₃₀ t ₁₂₀
T2 (50)	T ₅₀ t ₆₀	T ₅₀ t ₉₀	T ₅₀ t ₁₂₀
T3 (70)	T ₇₀ t ₆₀	T ₇₀ t ₉₀	T ₇₀ t ₁₂₀

Notes:

t = time reaction (minute);

T = temperature reaction(°C)

Before sulfonation is carried out, the PEEK pellets are dried in an oven at 100°C and vacuum pressure. The dry PEEK is then dissolved and reacted with high concentrations of sulfuric acid at certain time and temperature of reaction. To stop the reaction, the solution is poured into icy water so that white deposits are found. The deposits are washed several times using deionised water until the wastewater has a neutral pH. Afterwards, the sPEEK is dried in an oven at room temperature for 12 hours, followed by another condition process of drying i.e. 60°C for 12 hours. At the end, the sPEEK deposits are dissolved by stirring in DMAc

with a ratio of sPEEK/DMAc = 10% weight at room temperature for certain period of time.

RESULT AND DISCUSSION

The PEEK reacted (sulfonated) at 30 and 50°C for 60 and 90 minutes, resulted in deposits of sPEEK which were physically still as pellets. However, at reaction temperature of 70°C and all investigated time (60, 90, and 120 minutes) finer deposits of sPEEK were yielded. Some examples of sPEEK deposits are shown in Figure 1.



(a)



(b)



(c)

Figure 1. sPEEK sulfonated at 70°C and 120 minutes (a); at 70°C and 90 minutes (b); at 70°C and 60 minutes (c)

In fact, the different physical forms of sPEEK affect the solubility of sPEEK in the solvent of DMAc, as shown in Tabel 2.

Tabel 2. The solubility of sPEEK in DMAc

No.	Combination of Temperature (T) and Time (t)	Qualitative Solubility
1	$T_{30}t_{60}$	Not dissolved
2	$T_{30}t_{90}$	Not dissolved
3	$T_{30}t_{120}$	Not dissolved
4	$T_{50}t_{60}$	Not dissolved
5	$T_{50}t_{90}$	Not dissolved
6	$T_{50}t_{120}$	Not dissolved
7	$T_{70}t_{60}$	Dissolved partially
8	$T_{70}t_{90}$	Dissolved partially
9	$T_{70}t_{120}$	Dissolved partially

It was reported that the solubility of sPEEK in several solvents as DMAc, dimethylformamide, and dimethylsulfoxide was affected by DS, a parameter representing the amount of sulfuric acid reacting with PEEK [Zaidi, 2003]. At DS 70% sPEEK was dissolved completely in those solvents. As a matter of fact, the ion exchange capacity (IEC), one of important parameters for a membrane as proton exchanger, is also affected by DS. Zaidi (2003) and Othman et. al. (2008) found that the level of DS was strictly proportional to the value of IEC, and both values were affected by the temperature of sulfonation reaction. Briefly speaking, higher temperature of sulfonation increases DS and IEC.

It must be noticed that the dilution of sPEEK in DMAc solvent was conducted at room temperature; therefore, as shown in Table 2 no sPEEK were dissolved completely in DMAc. Theoretically, complete dilution of solid materials can be achieved by increasing the temperature. Nevertheless, a representative sheet of membrane was still obtained as shown in Figure 2.



Figure 2. A sheet of membrane produced from $T_{70}t_{120}$

CONCLUSION

The time and temperature of sulfonation affects the physical forms (shape and size) of sPEEK deposits, which eventually affect the solubility of sPEEK in DMAc. In the range of investigated time of reaction (60-120 minute) at reaction temperatures of 30 and 50°C the yielded sPEEK is not dissolved DMAc. It is recommended to carry out the PEEK sulfonation at least at 70°C.

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