International Journal of Engineering & Technology, 7 (4.29) (2018) 168-171

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Investigating the Agricultural Applications of Acryl Amide based Hydrogel

M. A. Radwan[1], Omar Al-Sweasy[2], M. A. Sadek[3], Hany A. Elazab[4]

[1,2,3,4] *Chemical Engineering Department, The British University in Egypt, BUE, Cairo, Egypt.*

Abstract

Hydrogel is classified as one of the most effective materials due to its widely used applications either in tissue or agriculture engineering. This scientific research aims to investigate the potential applications of hydrogels in the field of desert agriculture in dry places. In this research hydrogel was prepared under several conditions in order to evaluate and optimize the conditions. The research included optimizing several factors including cross-linking agent, water temperatures and pH. The potential agricultural applications of hydrogel were also investigated.

Keywords: *Hydrogel, optimization, Agricultural applications, Cross-linking agent, Sodium Polyacrylate.*

1. Introduction

Hydrogels are considered as one of the main polymeric classes due to its outstanding ability to absorb huge amount of water. Hence, they could have a significant impact on the development of deserts via absorbing water and then providing it to the plant roots. Hydrogel is classified as a super absorbent polymer with a three dimensional structure that can absorb large amounts of water.[1-4] This is actually important in many applications including not only wound dressing, baby diapers, and agriculture, but also including tissue engineering. [15-9] The essential advantage of using hydrogel is its unique permeability and its ability of storing water[10-14]. Hydrogels were also used in other applications including toys, agriculture, and many other uses [15-18].
Several research efforts have been devoted to design new polymer based systems that do not destroy plants or soil until hydrogels were discovered. Hydrogels were found to support farmers in reducing the amount used of fertilizers as hydrogel can simply separate between the soil particles and hence allow the fertilizers to be absorbed easily [19-22]. Finally, it is well established that hydrogels have many useful applications and it can be considered a hot topic like other field in material science, nanotechnology, and catalysis.[23-31]

2. Experimental

2.1. Materials

All chemicals used as used as received.

2.2. Preparation of PAMPS Hydrogels.

AMPS (5 g) was added to distilled water. Methylene-bis-acrylamide was then added to the previous mixture acting as a cross linking agent. Then, 0.02 g of ammonium persulphate which is serving as initiator was also added. Then, the entire solution was heted till constant weight at 60˚C.

2.3. Investigation of Factors Including Cross Linking Agent, Ph, Temperature.

As illustrated in figure 1, the following amounts: 0.03, 0.09, 0.15, 0.25, 0.35, and 0.55 g of the cross linking agent had been used to determine the water amount that was absorbed by the hydrogel.
To investigate the pH effect, 0.15 g Methylene-bis-acrylamide - cross linked PAMPS hydrogel was tested with water (pH = 7, 4, and 12). Hence, water temperature effect was investigated by being tested at the following temperatures 25˚C, 40˚C, and 60˚C.

2.4. Investigating Agricultural Applications of Hydrogel

An analogy has been made between hydrogels in implanting and common farming methods. Hydrogel was used under the surface of the soil, while the common methods were also applied to the plant.

3. Results and Discussion

3.1. Cross Linking Agent Percentage, Ph, Temperature, and Time Impact

Generally, figure 1 shows the effect of using several selected cross linking. It was found that curve (A) represent 0.03 g cross linker had the highest registered volume of absorbed water and subsequently curve (B) represent 0.09 g, curve (C) represent 0.15g, curve (D) represent 0.25g, curve (E) represent 0.35 g and finally curve (F) represent 0.55 g was found to be with the minimum registered amount of water absorbed per unit weight. [13]

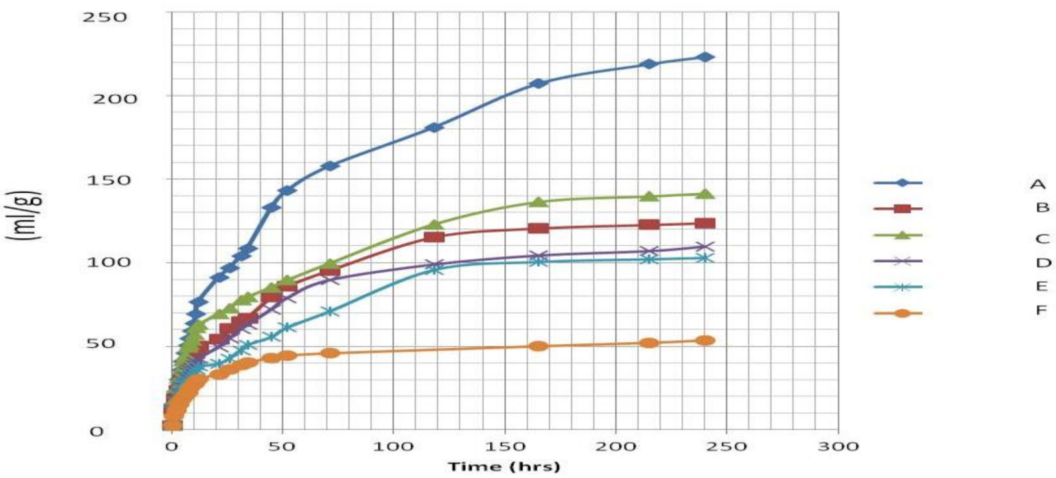

Figure1: Diversity Study of Various cross linking densities.

Figure 2 shows that using curve (C) represent alkaline water increasing the amount of the absorbed water, followed by hydrogel using curve (B) represent acidic water, and curve represent neutral water respectively

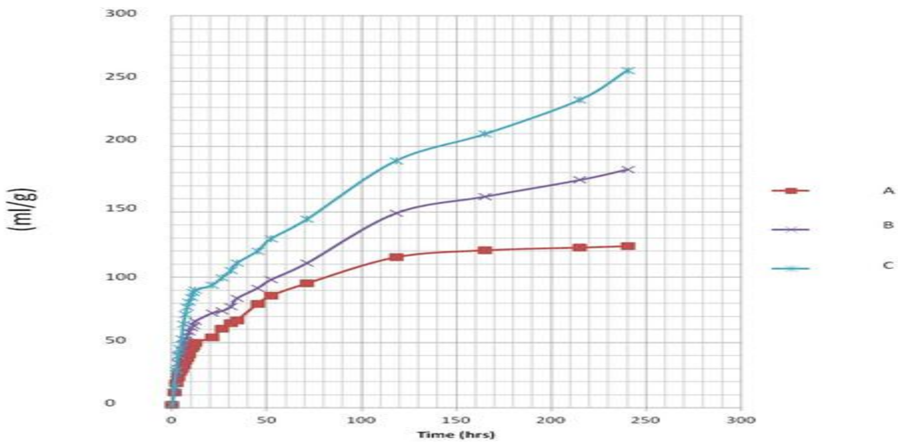

Figure2: Time Effect at Different Values of pH

Figure 3 shows that curve (C) represent the highest volume of water absorbed at temperature 60˚C, followed by curve (B) at temperature 40˚C, and finally curve (A) at temperature 25^{o}C.

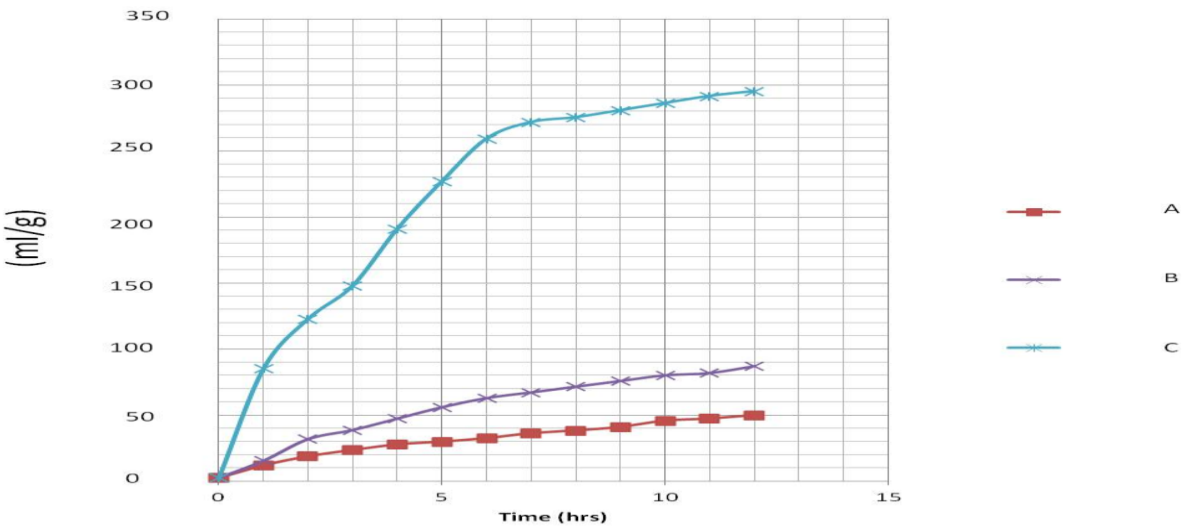

Figure3: Effect of time at different water temperatures.

3.2. Potential Applications in Agriculture

Hydrogel was investigated in potential agricultural applications in comparison with other adopted regular methods. Crystals of hydrogel were added beneath the surface of the soil through using only a thin layer. It is obvious from figure 4 that using hydrogel made a great improvement and enhancement.

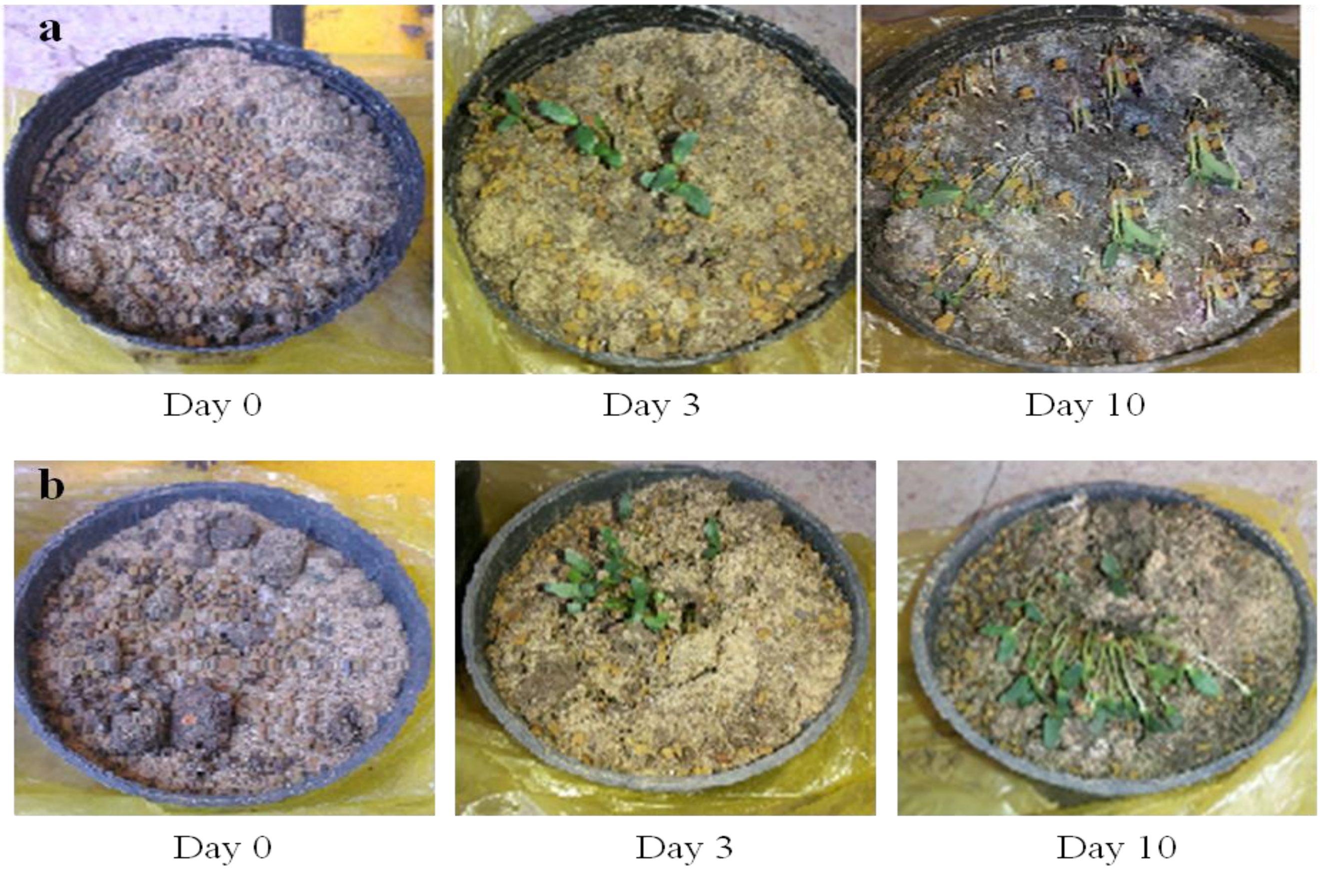

Figure4: The Effect on Perofrmance (a) without hydrogel (b)with hydrogel.

4. Conclusion

Different types of PAMPS hydrogel were investigated at different conditions. Many variables were altered in order to optimize the process. Hydrogel was also tested for potential agricultural applications.

References

[1] Buchholz F.L. and Graham A.T., Modern Superabsorbent Polymer Technology, Wiley-VCH, New York, 1998.

[2] Brannon L. and Horland R.S., Absorbent Polymer Technology, J Controlled Release, 17 (3) (1991), PP.297-298.

[3] Hennink W.E. and Nostrum C.F. (2002) Novel Cross Linking Methods to Design Hydrogels. Advanced Drug Delivery Reviews 54 13-36.

[4] Rosiak J.M. and Yoshii F. (1999), Hydrogels and their medical applications. Nuclear Instrument and Methods in Physics Research B 151, 56-64.

[5] Dayal U., Mehta S.K., Choudhari M.S. and Jain R., Synthesis of Acrylic Superabsorbents, J MacromolSci-Rev MacromolChemPhys, C39, 507-525, 1999.

[6] Buchholz F.L. and Peppas N.A., Superabsorbent Polymers Science and Technology, ACS Symposium Series, 573, American Chemical society, Washington, DC, Ch 2, 7, 8, 9, 1994.

[7] Brannon L. and Harland R.S., Absorbent Polymer Technology, Elsevier, Amsterdam, Ch 1-4, 1990.

[8] Superabsorbent hydrogels, Website of the leading Iranian manufacturer of superabsorbent polymers; Rahab Resin Co., Ltd.; 10 September 2007.

[9] Superabsorbents, Website of the European Disposables and Nonwovens Association (EDANA); www.edana.org, available in 28 May 2008.

[10] Carpi A., Analysis and Modelling to Technology Applications, ISBN: 978-953-307-268-5.

[11] Lugao, A. B. &Malmonge, S. M. (2001) Use of Radiation in the Production of Hydrogels. Nuclear Instruments and Methods in Physics Research B 185, 37-42.

[12] 12-Yue H., Liao .L, Li. X. and Cui. Y., (2009), Study on the Swelling, Shrinking and Bending Behavior of Electric Sensitive Poly (2-acrylamido-2-methylpropane sulfonic acid) Hydrogel, P. 115-117.

[13] Radwan M. and Al-Swuasy O., (2014), Graduation Project Thesis, Chemiccal Engineering Deptment, The British University in Egypt.

[14] Jhurry. D., (1997). Food and Agricultural Research Council, Reduit, Mauritius 109, Agricultural Polymers, AMAS 1997, University of Mauritius.

[15] Ecofriend, (2010). Belgian scientist uses hydrogels to turn dirt into gardens.

[16] Sannino. A., (2008). Application of Superabsorbent Hydrogels for the Optimization of Water Resources in Agriculture. Department of Innovation Engineering, Universityof Salento, Monteroni, Italy.

[17] Elazab, H., et al., Microwave-assisted synthesis of Pd nanoparticles supported on FeO, CoO, and Ni(OH) nanoplates and catalysis application for CO oxidation. Journal of Nanoparticle Research, 2014. 16(7): p. 1-11.

[18] Elazab, H., et al., The Effect of Graphene on Catalytic Performance of Palladium Nanoparticles Decorated with FeO, CoO, and Ni (OH): Potential Efficient Catalysts Used for Suzuki Cross-Coupling. Catalysis Letters. 147(6): p. 1510-1522.

[19] Elazab, H.A., et al., The continuous synthesis of Pd supported on Fe3O4 nanoparticles: A highly effective and magnetic catalyst for CO oxidation. Green Processing and Synthesis. 6(4): p. 413-424.

[20] Elazab, H.A., M.A. Sadek, and T.T. El-Idreesy, Microwave-assisted synthesis of palladium nanoparticles supported on copper oxide in aqueous medium as an efficient catalyst for Suzuki cross-coupling reaction. Adsorption Science & Technology. p. 0263617418771777.

[21] Elazab, H.A., et al., Highly efficient and magnetically recyclable graphene-supported Pd/Fe3O4 nanoparticle catalysts for Suzuki and Heck cross-coupling reactions. Applied Catalysis A: General, 2015. 491: p. 58-69.

[22] Mankarious, R.A., et al., Bulletproof vests/shields prepared from composite material based on strong polyamide fibers and epoxy

resin. Journal of Engineering and Applied Sciences. 12(10): p. 2697-2701.
[23] Mohsen, W., M.A. Sadek, and H.A. Elazab, Green synthesis of copper oxide nanoparticles in aqueous medium as a potential efficient catalyst for catalysis applications. International Journal of Applied Engineering Research. 12(24): p. 14927-14930.
[24] Radwan, M.A., et al., Mechanical characteristics for different composite materials based on commercial epoxy resins and different fillers. Journal of Engineering and Applied Sciences. 12(5): p. 1179-1185.
[25] Hany A. Elazab, "The catalytic Activity of Copper Oxide Nanoparticles towards Carbon Monoxide Oxidation Catalysis: Microwave – Assisted Synthesis Approach", "Biointerface Research in Applied Chemistry", Volume 8, Issue 3, 3278 – 3281, June 2018.
[26] Hany A. Elazab, "Laser Vaporization and Controlled Condensation (LVCC) of Graphene supported Pd/Fe3O4 Nanoparticles as an Efficient Magnetic Catalysts for Suzuki Cross – Coupling.", "Biointerface Research in Applied Chemistry", Volume 8, Issue 3, 3314 – 3318, June 2018.
[27] Fatma Zakaria, M. A. Radwan, M. A. Sadek, H. A. Elazab International Journal of Engineering and Technology(UAE), 7, 2018.
[28] Reem Nasser, M. A. Radwan, M. A. Sadek, H. A. Elazab International Journal of Engineering and Technology(UAE), 7, 2018.
[29] Mostafa Ghobashy, Mamdouh Gadallah, Tamer T. El-Idreesy, M. A. Sadek, H. A. Elazab International Journal of Engineering and Technology(UAE), 7, 2018.
[30] H. A. Elazab, M. A. Sadek, Biointerface Research in Applied Chemistry, 8, 2018.
[31] Hany A. Elazab, The Canadian Journal of Chemical Engineering, volume 96, issue 10, 2018.