Skin-care Finishing Using New MPCE Polymer

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1. INTRODUCTION

Environmental technology (ET) is already one of the most important technology area throughout the world and the demand of environmental friendly and biocompatible products are continuously increasing. Also in textile industry, lots of functional eco products such as antimicrobial, deodorization, skin aging and atopy prevention, and moisturizing are continuously developed and introduced. Especially, biocompatible moisture finishing products for skin protection such as squalene, collagen, chitosan, hyaluronic acid, and ceramide are very wide spread in cosmetics or health care area.

However, in textile industry, these materials were not so popular since the performance was unsatisfactory when applied to synthetic fibers. Phospholipid polymer known as lipidure consists of hydrophilic phosphoric acid parts and hydrophobic lipid parts forming fats. It was already verified that they have functions of moisturizing, anti skin aging, anti-microbial and excellent stability since they have similar structures to cell membrane.In this study, new biocompatible muti-functional textile finishing agents based on phospholipid MPCE copolymer was synthesized and characterized. Also the finishing agent was developed with synthesized polymers in various conditions and evaluated for their properties.

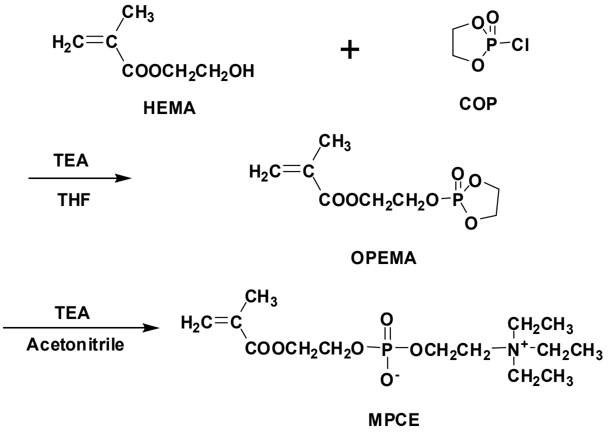

Fig. 1. Synthesis of MPCE.

2. EXPERIMENTAL

2.1 Synthesis of MPCE polymer

Dry THF was placed into a 500 ml double walled vessel, and triethylamine (TEA) and 2-hydroxyethyl methacrylate (HEMA) were added to the solution. After the solution was cooled at 0 ℃, 2-chloro-2-oxo-1,3,2-dioxaphospholane (COP) in dry THF were added dropwise over a period of 1hr. The temperature of the reaction mixture was maintained at room temperature for 4hr. Then, the precipitate in the reaction mixture which was triethylammonium chloride was filtered off and the filtrate was evaporated under reduced pressure. OPEMA and dry acetonitrile were placed in a two-necked flask and triethylamine were added to the solution. After it was heated at 60℃ for 48h, the mixture was evaporated under reduced pressure. Evaporated under pressure to give colorless liquid produce, MPCE.

Synthesized MPCE were polymerized by homo-polymerization or copolymerization with biocompatible monomer which were HEMA, NIPAM and carboxylic acid substituted NIPAM.

2.2 Formulation

Good moisture regain and anti-static charge properties were verified when treated with Lyoprint PBA as binder, Hydrophobol XAN as cross-liking agent, and TWEEN20 as surfactant. These properties of treated textiles were significantly better than the untreated fabric. Also, it was confirmed that the optimal finishing condition was 1% MPCE, 1% PBA and 0.3% XAN at pH4.

Table 1. Applied MPCE polymer and additive agent

No.	MPCE polymer	Additive agent
1	MPCE polymer A	Binder
2	MPCE polymer B	: Lyoprint PBA
3	MPCE:HEMA 1:5	
4	MPCE-NIPAM 1:5	Cross-linking agent
5	MPCE-NIPAM(-COOH) 1:5	: Hydrophobol XAN
6	MPCE-HEMA 1:1	
7	MPCE-NIPAM 1:1	Surfactant
8	MPCE-NIPAM(-COOH) 1:1	: Tween 20

2.3 Property measurement

Biocompatible functionality of MPCE treated textile was evaluated by measurement of moisture regain, wetting test, frictional static charge, anti-bacterial effect and skin irritation activity. Measured polymers were MPCE homopolymer and copolymer which were polymerized by varying monomers and polymerization ratio, and numbered 1 to 8.

3. RESULTS

Moisture regain of the MPCE treated PET

It was observed that the overall moisture regain was increased 2~4 times in MPCE treated PET compared with control fabric, because fabric surface was endowed hydrophilic properties.

Frictional static charge of the MPCE treated PET

The frictional static charge was significantly decreased in MPCE treated PET due to improved moisture regain.

Anti-bacterial effect of the MPCE finishing agent

The results indicated that the MPCE finishing agent showed anti-bacterial effect, meaning that the bacteria could be completely killed by the phospholipid polymers.

Skin barrier function recovery effect

Table 3 shows that skin barrier function recovery test after SDS treatment and the recovery rate was calculated by following equation. From this result, MPCE polymers were effective in skin recovery function.

$$\text{Recovery rate}(\%) = \frac{T_1 - T_2}{T_2 - T_0} \times 100$$

T_0 : water loss before SDS treatment
T_1 : water loss after SDS treatment
T_2 : water loss after removal of MPCE treated textile

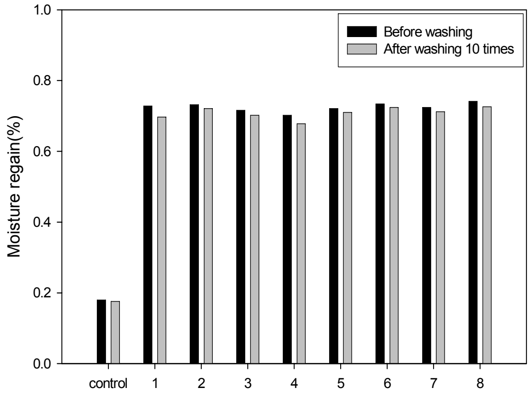

Fig. 2. Moisture regain of MPCE treated textile.

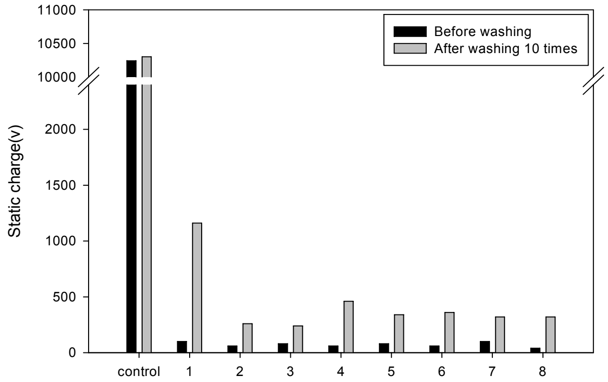

Fig. 3. Static charge of MPCE treated textile.

Table 2. Anti-bacterial test

Sample	ATCC 6538		
	0 h	18 h	Percentage of removal
Control	2.3×10^4	3.9×10^6	-
MPCE	2.3×10^4	<10	99.9
MPCE-HEMA	2.3×10^4	<10	99.9
MPCE-NIPAM	2.3×10^4	<10	99.9
MPCE-NIPAM (-COOH)	2.3×10^4	<10	99.9

Table 3. Trans-epidermal water loss by Tewameter

Subject	MPCE polymer		Before SDS treatment	After SDS treatment	After removal	Recovery rate
Male	2	untreated	12.8	27.3	21.1	42.8
		treated	12.6	32.4	21.6	54.5
	5	untreated	19.5	37.2	25.8	64.4
		treated	13.8	36.8	21.8	65.2
Female	2	untreated	19.3	34.6	21.9	83.0
		treated	17.3	30.9	19.1	86.8
	5	untreated	19.7	27.6	25.5	26.6
		treated	17.3	30.3	18.3	92.3

4. REFERENCE

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[2] K. Ishihara, T. Ueda, and N. Nakabayashi; Preparation of Phospholipid Polymers and Their Properties as Polymer Hydrogel Membranes, J.Polymer, 20(5), 355-360(1990).