Evaluation of Various Materials for Cleaning of Processing Area and Equipment After Using POLYOX™ Polymers

APPLICATIONS DATA SUMMARY

Cleaning techniques and recommended detergents for POLYOX™, water soluble resins, are presented:

- First Choice: Bernite 29 (hot 40ºC tap water; 20% w/w and 20 min soaking time or 50% w/w and 5 min soaking time)
- Second Choice: Sodium carbonate (hot 40ºC tap water; 20% w/w and 20 min soaking time or 50% w/w and 5 min soaking time)
- Third Choice: IPA (5 min soaking time)

INTRODUCTION

Polyethylene oxide (PEO) polymers, available commercially under the trade name of POLYOX™ water soluble resins (WSR), are novel materials with unique properties. They have found a number of uses in pharmaceutical applications such as extended release (ER) matrices[1, 2], osmotic pumps, in mucosal bio-adhesives, in melt extrusion and in gastro-retentive dosage forms.

POLYOX™ polymers are free flowing white crystalline powders with an average particle size of around 150 μm. They are non-ionic, highly swelling, thermoplastic and soluble in water and selected organic solvents.

The high visco-elasticity of high molecular weight POLYOX™ polymers in aqueous environments creates difficulties in the cleaning of a powder or solution spill. The aim of this study was to evaluate various materials for cleaning processing equipment after PEO use.

MATERIALS AND METHODS

Residues of POLYOX™ WSR-303 (Colorcon, UK) were cleaned using various materials and 40ºC tap water (Table 1). Health and safety information is presented in Table 2.

Table 1. Cleaning Materials Used in the Study

Material	Supplier	Material concentration in water (% w/w)	Soaking time (min)
Bernite 29 (alkaline powder containing surfactant, sodium dodecylbenzene sulphonate),	Hubbard-Hall, USA	5 20 50	30 20 5
Emerald SF (small foam aqueous solution), Emerald HD (heavy duty mildly alkaline solution)	Hubbard-Hall, USA	5 20 50	30 20 5
Chematic 99, 405, 410 and 453 (liquids)	Dober Group, USA Doronwell Ltd, UK	5 20 50	30 20 5
Isopropyl alcohol USP/EP/JP	Hayman Ltd, Germany	-	5
Sodium carbonate anhydrous	Acros Organics, Belgium	5 20 50	10 5 5
Sodium bicarbonate		5 20 50	10 5 5

Table 2. Health and Safety Information for Cleaning Materials Used in the Study

Product	National Fire Protection Association (NFPA) Health (H)	Flammability (F)	Reactivity (R)
Bernite 29	1	0	0
Isopropyl alcohol	1	3	0
Sodium carbonate	2	0	0
Sodium bicarbonate	1	0	0
Chematic 99	2	0	0
Chematic 405	1	0	0
Chematic 410	1	0	0
Chematic 453	2	2	0
Emerald SF	1	0	0
Emerald HD	1	0	0
Ethanol	2	3	0

Scale is as follows: 0 – is the least hazardous material, 3 – is the most hazardous material.

Prior to applying any cleaning solvents or solutions, dry POLYOX™ powder was removed using a vacuum cleaner. After cleaning, the surfaces were rinsed with water to remove residues of POLYOX™ film and cleaning solution.

In order to avoid potential irritation to the skin by cleaning agents used, personal protection clothing was worn during the clean-up procedure.

Results and Discussion

Results are summarized sin Table 3.

Table 3. Results Produced with Cleaning Materials Used in the Study

Material	Advantages	Disadvantages
Bernite 29	Good results, easy to clean No odour, environmentally friendly	None
Chematic (99, 405, 410 and 453)	None	Very difficult to clean for all concentrations
Isopropyl alcohol USP/EP/JP	Excellent results; very easy to clean	Strong alcoholic smell, flammable
Emerald SF and HD	None	Very difficult to clean for all concentrations
Sodium carbonate anhydrous	Excellent results for 20 and 50% w/w, very easy to clean 5% w/w solution required more soaking time No odour, environmentally friendly	Some white marks after cleaning were seen on the surfaces and therefore extra wash-up with water was required
Sodium bicarbonate	None	Not an efficient cleaner Very difficult to clean for all concentrations

Conclusions and Recommendations

Taking into account the health and safety information presented in Table 1 and 2, and the results summariszed in Table 3, the following materials are recommended to be used for cleaning equipment after POLYOX™ use in the order of preference:

First Choice: Bernite 29 29 (hot 40ºC tap water; 20% w/w and 20 min soaking time or 50% w/w and 5 min soaking time)
According to the NFPA classification it is the least hazardous material.
Bernite 29 is manufactured and supplied globally by Hubbard-Hall: http://hubbardhall.com/about/locations.shtml

Second Choice: Sodium carbonate carbonate (hot 40ºC tap water; 20% w/w and 20 min soaking time or 50% w/w and 5 min soaking time)
According to the NFPA system it has the following classification: H = 2 and F=0.
Sodium carbonate was found to be an effective cleaner, due to a salting out effect. There by, effectively causing POLYOX to precipitate. It is known that the presence of certain inorganic salts, such as sodium carbonate in aqueous solutions, can have a dramatic effect on the solubility of PEO. Selection of a cleaning agent should also take into account the solubility and cleaning characteristics of other ingredients, particularly API, when present at high concentration.

Third Choice: : IPA (5 min soaking time)

This is a very efficient cleaner. According to the NFPA system it is not hazardous (H = 1), but is flammable (F = 3).

In all cases, in order to ensure the adequate health and safety for the operator, the following actions should be carried out:

- Chemical hazard assessments prior to use
- Adequate personal protection to be employed: such as protective gloves, eye protection and lab coats
- Cleaning to be carried out in a well ventilated area using available air extract systems.

REFERENCES

1. Choi S.U., Lee J., Choi Y.W., 2003. Development of a directly compressible poly(ethylene oxide) matrix for the sustained-release of dihydrocodeine bitartrate. Drug Dev. Ind. Pharm., 29, 1045-1052.

2. Li H., Hardy R.J., Gu X., 2008. Effect of drug solubility on polymer hydration and drug dissolution from polyethylene oxide (PEO) matrix tablets. AAPS PharmSciTech, 9(2), 437-443.

For more information, contact your Colorcon representative or call:

North America	Europe/Middle East/Africa	Asia Pacific	Latin America
+1-215-699-7733	**+44-(0)-1322-293000**	**+65-6438-0318**	**+54-11-4552-1565**

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