

Mixing system: Newmix®- Levtech® Pad-Drive™ 1000 system

Mixing bag: 200L

Mixing type: Solid-liquid

The Newmix-Levtech Pad-Drive system is a scalable and non-invasive single-use mixing system. The heart of this mixer is an innovative top-mounted mixing paddle that allows effective and uniform mixing in demanding applications, such as preparation of contained high-solids solutions or mixing of high-viscosity liquids.

Introduction

Certain mixing applications can result in exothermic behavior. A common example is the dissolution of solid sodium hydroxide (NaOH) in water, during which the heat of solvation can cause local temperatures in the mixing vessel to approach the melting temperature of the bag film. Such elevated temperatures could result in melting of the LDPE contact layer, and even structural failure of the mix bag.

In this experiment, a Pad-Drive 1000 was used to prepare 50L of 0.5M and 1M NaOH solutions. The test bag was made from pure LDPE, instead of the more temperature-tolerant laminated films normally used in Pad-Drive mixing bags, to present a worse-case scenario in this exothermic application. The objective was to demonstrate how proper management of the mixing sequence can avoid local hot-spots in the mixing bag, and thus ensure bag integrity throughout the mixing process.



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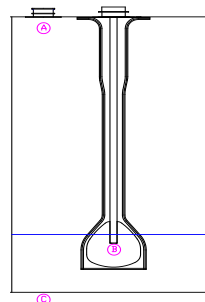
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Application note XA008E 0810rev3

Experimental

A 200L LDPE mixing bag was filled with 50L of water, and then the required quantity of NaOH pellets was added via the powder inlet triclamp port (location “A” in the accompanying drawing) to make 0.5M or 1M solutions. The temperature was then recorded in two locations (“B” and “C” in the drawing). Testing was performed with mixing at 35rpm at a 9° mix angle, and then without any mixing.



Results

The accompanying table shows temperatures in the mixing bag at the indicated locations and specified conditions:

Mix Speed	Water Qty	NaOH Qty	Solution Concentration	Measurement Location B		Measurement Location C	
				T _{start} (°C)	T _{end} (°C)	T _{start} (°C)	T _{end} (°C)
35rpm	50L	1.0kg	0.5M	12°C	20°C	11°C	17°C
35rpm	50L	2.0kg	1.0M	11°C	22°C	10°C	20°C
0rpm	50L	1.0kg	0.5M	11°C	22°C	10°C	53°C

As the table shows, the temperature increased much more in unstirred conditions compared with stirred conditions, but at no time did the temperature approach either the softening point (92°C), or the melting point (122°C) of the LDPE bag material.

Conclusions

Although not recommended for such applications, even this pure LDPE bag can be used to prepare NaOH solutions up to 1M strength, provided mixing is initiated BEFORE the NaOH solid is added, so as to avoid local hot-spots in the mixing bag. With slower addition of NaOH, the chance of overheating is reduced still further.

For preparation of NaOH solutions, ATMI recommends a Q-Mix bag made with an ATMI barrier film (e.g. TK2) in conjunction with mixing while adding the NaOH solid. For applications where extreme heat generation is expected, users should consider a jacketed, temperature-controlled mix vessel.