

# Monsanto

FROM  
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SUBJECT : BLOCKED ISOCYANATE ADHESIVES

REFERENCE :

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## SUMMARY:

Stable, thermoset blocked isocyanate adhesives may be prepared as 100% active one-part hot melt, liquid or two-part systems. Santicizer 8, MXP 2020 and possibly Santicizer 160 are useful Monsanto products. Excellent bonds of gum stock or nitrile rubber to Osnaberg, polyester, nylon tufted polypropylene, nylon, and cotton fabrics may be achieved.

This work was begun to assist Apache Mills and Master Adhesives in finding easily handled adhesive systems to improve bonds of nylon tufted polypropylene scrim to rubber backing in the manufacture of walk-off mats. The technology of bonding nylon to rubber is basically tire cord primer technology and is well known. The problem of blocking isocyanates (reacting the isocyanate with (e.g.) a phenolic so it is unreactive until thermally activated) is relatively well defined (see E. N. Doyle, "The Development and Use of Polyurethane Products"). A combination of these two technologies with Monsanto's plasticizer family is a particularly neat way of solving the problem.

## DESCRIPTION AND DETAILS:

For a general preparation the PAPI or other isocyanate is dissolved in Santicizer 8. Phenol, if used, is dissolved in MXP-2020 or Santicizer 160, and added to the PAPI solution. The system is stirred 1 hour at 60°C under a nitrogen blanket and allowed to cool to 25-30°C. When cool epoxy resin, PVC, etc., may be added. The system is bottled and stored for coating.

The rubber and/or fabric may be coated. The adhesive will thermoset at 110-170°C. Typical formulas and results are summarized. Please note formula #4 is a two-part, unblocked control type formula.

|                   | <u>1</u>                          | <u>2</u> | <u>3</u> | <u>4 *</u>          |
|-------------------|-----------------------------------|----------|----------|---------------------|
| Phenol            | 15                                | 5        | -        | -                   |
| MXP-2020          | 20                                | 20       | 10       | 20)                 |
| PAPI              | 30                                | 30       | 30       | 30) Part A          |
| Santicizer 8      | 30                                | 30       | 30       | -                   |
| Epon 828          | 25                                | 25       | -        | 25) Part B          |
| Storage Stability | > 2 months--                      |          |          | (Two-part adhesive) |
| Characteristics   | Warm                              |          |          |                     |
|                   | Melt Fluid Fluid (Two-part/fluid) |          |          |                     |
|                   | (Flow Freely)                     |          |          |                     |
|                   | at 35°C                           |          |          |                     |

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{ Coated 10 mil on uncured nitrile rubber sheet. Laminated nylon fabric  
 { and/or polypropylene scrim to coated rubber and cured @150°C in press.  
 { Measured T-peel on Instron.  
 { \*For sample number four part A was coated on the scrim and part B on  
 { the rubber.

Peel (lbs./inch width)

|       |     |     |     |     |
|-------|-----|-----|-----|-----|
| Scrim | 6.5 | 3.0 | 4.0 | 5.5 |
| Nylon | 6.8 | 6.8 | 7.6 | 8.5 |

All scrim samples showed delamination to rubber. All nylon samples showed rubber substrate failure. (Tore the substrate before the adhesive bond broke.

Sample number three is, of course, most attractive as it is essentially a physical blend and minimal effort is required to prepare it. It is noteworthy that the 2 month old blocked samples gave very good results in comparison to the two part control. Sales points to cover include:

1. Ease of Blocking
2. Stability
3. 100% Solids
4. Fits typical lamination procedure
5. Fluid (easy to coat)
6. Versatile bonding system.

Additional data includes (150°C/10 min. cure of 10 mil coat on gum rubber)

|              | <u>5</u> | <u>6</u> | <u>7</u> | <u>8</u> |
|--------------|----------|----------|----------|----------|
| Phenol       | 15       | 5        | -        | -        |
| MXP 2020     | 20       | 20       | 20       | 10       |
| PAPI         | 30       | 30       | 30       | 30       |
| Santicizer 8 | 30       | 30       | 30       | 30       |
| Epon 828     | 25       | 25       | 25       | -        |

| T-peel (lbs./in.)       |         |         |          |          |
|-------------------------|---------|---------|----------|----------|
| Gum Rubber to Nylon     | 2.2-4.5 | 2.0-3.0 | 1.5-11.0 | 2.4      |
| Gum Rubber to Osnaberg  | 2.2-4.8 | 1.7-2.0 | 1.7-3.8  | 1.5 plus |
| Gum Rubber to Cotton    | 2.0-4.3 | 1.9     | 1.5-3.0  | 1.0 plus |
| Gum Rubber to Polyester | 2.0-4.3 | 1.2-5.0 | 2.2-15.6 | 1.4 plus |

In most cases the gum stock tore badly resulting in "shocky," uneven pulls. Again, substrate failure was seen.

To compare MXP-2020 and Santicizer 160 direct comparisons were made on gum rubber (10 mil coating, 10 min. 150°C cure on cured gum rubber).

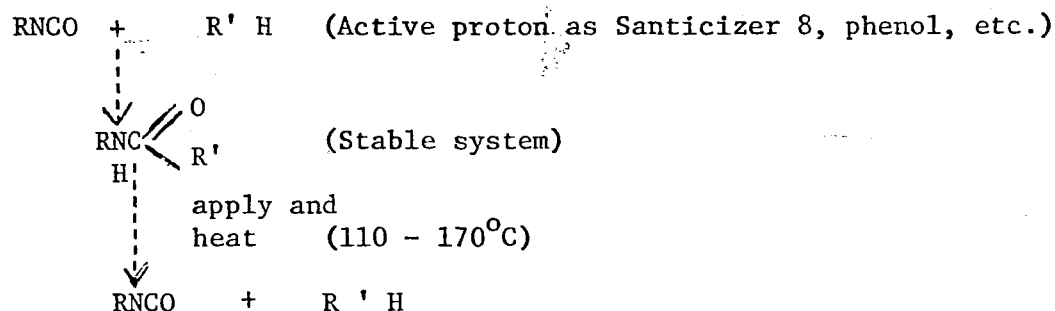
|                | <u>9</u> | <u>10</u> | <u>11</u> | <u>12</u> |
|----------------|----------|-----------|-----------|-----------|
| Santicizer 160 | -        | 20        | 20        | -         |
| MXP-2020       | 20       | -         | -         | 20        |
| PAPI           | 30       | 30        | 30        | 30        |
| Santicizer 8   | 30       | 30        | -         | -         |
| Epon 828       | 25       | 25        | 25        | 25        |

(#11 and #12 2 part adhesive)

|                         |     |     |     |     |
|-------------------------|-----|-----|-----|-----|
| T-Peel(lbs./in.)        |     |     |     |     |
| Gum Rubber to Nylon     | 2   | 1.1 | 1.4 | 4.5 |
| Gum Rubber to Cotton    | 3.5 | 1.4 | 1.2 | 3.5 |
| Gum Rubber to Polyester | 8.5 | 2.0 | 1.8 | 2.5 |

Obviously, MXP-2020 brings something to the party that Santicizer 160 doesn't, but with formulation variation the benzyl performance could be improved. The surprisingly low Nylon value for sample 9 (compare to 7) was apparently caused by a rip in the substrate.

As discussed, we will submit the preparation data and a couple of trial formulas to Apache Mills and to Master Adhesives. This is a highly versatile formulation and should be applicable to a number of "hard to bond" substrates. To refresh your memories, the chemistry involved is:



(This now reacts with epoxy, nylon, etc. to form the bond)

AWM/gls

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