

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

April 20, 2016

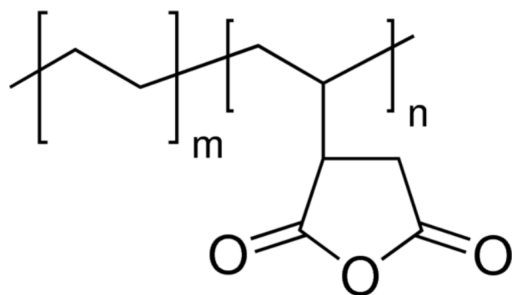
TO: File for Maleic Anhydride with Ethylene, Polymer (CAS# 9006-26-2)
FROM: Michael Depa, Air Quality Division, Toxics Unit
SUBJECT: Screening Level Derivation

The initial threshold screening level (ITSL) for maleic anhydride with ethylene, polymer will not be developed at this time. The National Ambient Air Quality Standards (NAAQS) for particulate matter should be used to evaluate emissions of poly(ethylene-maleic anhydride).

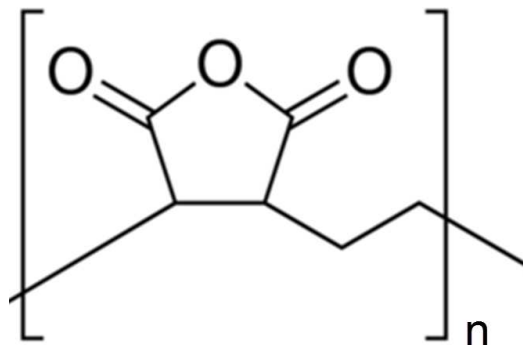
A search of the internet, RTECS (2016), US Environmental Protection Agency's ACTOR (US EPA ACTOR. 2016), TSCATS database (US EPA TSCATS. 2016), European Chemical Agency's REACH database (ECHA, 2016) and SciFinder did not reveal toxicity information suitable for deriving a screening level. Maleic anhydride with ethylene, polymer (see molecular structure in Figure 1a and 1b) is expected to be a solid with high molecular weight (100,000 – 500,000 g) at standard temperature and pressure. It is water soluble.

One of the monomers of Maleic Anhydride with Ethylene, Polymer is maleic anhydride (2,5-Furandione; CAS No. 108-31-6). Maleic anhydride has an ITSL of 0.1 $\mu\text{g}/\text{m}^3$ with an 8-hr averaging time. The ITSL for maleic anhydride is based on 1% of the Threshold Limit Value (TLV) of 0.01 mg/m^3 ; to protect for the potential effects of respiratory irritation (ACGIH, 2011).

Figure 1. Two Molecular Structures of Maleic Anhydride with Ethylene, Polymer



1a. Maleic Anhydride as Off-branch
"Polyethylene-graft-maleic anhydride"
(Sigma-Aldrich, 2016)



1b. Maleic Anhydride In-line with Ethylene
"Poly(ethylene-alt-maleic anhydride)"
(Sigma-Aldrich, 2016)

Sigma-Aldrich (2016) lists the following properties and description of Poly(ethylene-alt-maleic anhydride):

- Form: powder
- Molecular Weight: average 100,000-500,000 g
- Application: Viscosity modifier for solution, suspension or emulsion. Dispersing aid for insoluble solids.
- Features and Benefits: Forms a gel in water. Films from aqueous or organic solutions have high tensile and cohesive strength.
- Melting Point: 235 °C

The reaction of maleic anhydride and ethylene is proposed in Figure 2.

Figure 2. Proposed Polymerization of Maleic Anhydride and Ethylene

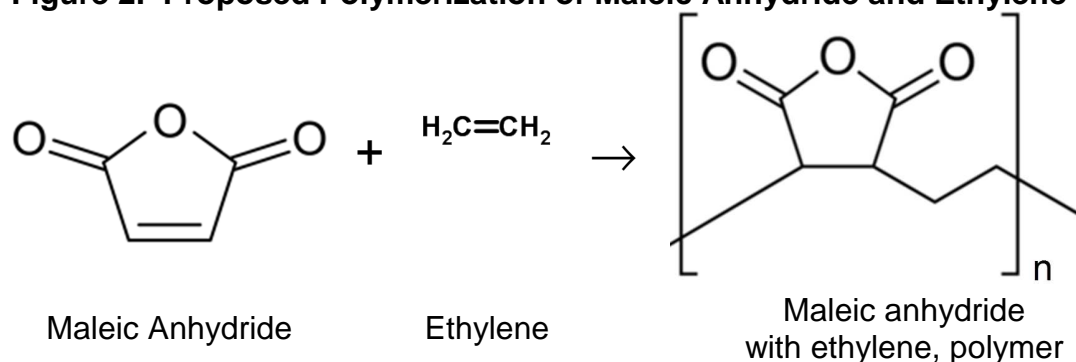


Figure 3. Hydrolysis of Maleic Anhydride to Maleic Acid (NIST, 2016)

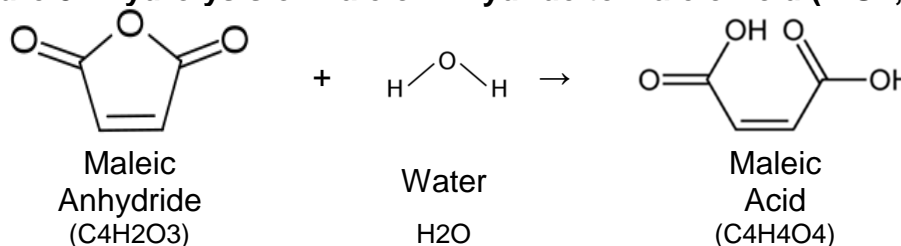


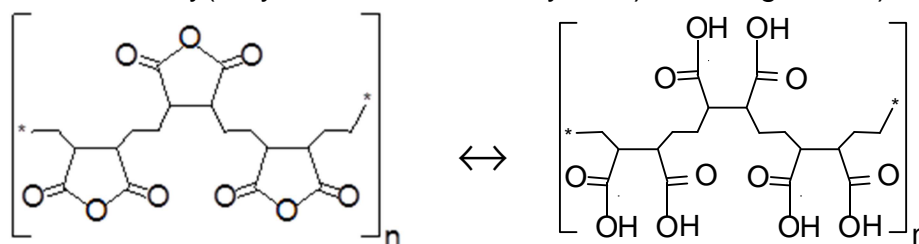
Table 1. Enthalpy Change from Hydrolysis of Maleic Anhydride (NIST, 2016)

Quantity	Value*	Units	Comment	Reference
Δ_rH°	-34.9 ± 0.8	kJ/mol	liquid phase; Heat of hydrolysis at 303 K	Conn, Kistiakowsky, et al., 1942

*Note: a negative enthalpy indicates an exothermic reaction

Based on the above hydrolysis reaction of maleic anhydride with water (see Figure 3) the following hydrolysis of “Poly(ethylene-alt-maleic anhydride)” is proposed in Figure 4:

Figure 4. Proposed Hydrolysis of Maleic Anhydride with Ethylene, Polymer
 (“In-line version” or “Poly(ethylene-alt-maleic anhydride)”); see Figure 1b.)



References

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