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## **AFEX™**

### **UNIQUE FUNCTIONAL OILS**

**AFEX™** is a series of products based on functional oils, which are manufactured through a patent pending technology. **AFEX™** made from plant oils such as tung, linseed, soybean, corn, peanut and canola oils etc. have hydroxyl groups (OH) and/or unsaturated double bonds depending upon whether the original oils are drying, semi-drying or non-drying in nature. The hydroxyl group functionality of **AFEX™** can be from one to three; and the molecular weight can be low or high depending upon the applications.

#### ***What Can AFEX™ do for you?***

**AFEX™** can be directly used as a raw material or as an additive in the preparation or formulating of coatings, adhesives, sealants, foams, composites and special products based on the chemistry of urethane or melamine. Functionality and molecular weights of the selected **AFEX™** will affect the final properties of the products modified by **AFEX™**.

Using **AFEX™** with low molecular weight and high functionality will provide the following benefits:

- Increase cross-linking density
- Increase cohesive energy density
- Increase modulus

Using **AFEX™** with high molecular weight and low functionality will provide the following benefits:

- Increase elongation
- Improve low temperature resistance
- Increase peel strength

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The **AFEX™** series of tung oil are the most interesting because they contain both three conjugated double bonds and various hydroxyl group levels. These conjugated double bonds will be opened through oxidation, in the presence of a catalyst, resulting in an increased cross-linking density and improved overall performance.

### ***Some Potential Applications***

#### **Waterborne polyurethane (wpu) coatings or adhesives**

Specific **AFEX™** products can be added into the polyol part in the preparation of wpu. The resultant one component wpu will have the potential cross-linking capability through oxidation to open the double bond. As a result, it will become a thermosetting wpu instead of a thermoplastic wpu, resulting in improved water and chemical resistance. Final properties of the wpu will be affected by the amount and specific functionality of the chosen **AFEX™** product.

#### **Waterborne or solvent-based melamine coatings or adhesives**

**AFEX™** can be used as part of the OH-containing mixture in the preparation of melamine based coatings and adhesives. The resultant products will have the potential cross-linking capability through oxidation to open the double bond. As a result, it will increase the cross-linking density of the final product.

#### **Waterborne or solvent-borne polyurethane sealants**

**AFEX™** can be used as part of the polyol in the preparation of 1K or 2K polyurethane sealants. Using specific **AFEX™** products, the resultant polyurethane sealants will have the potential cross-linking capabilities through oxidation, providing improved water and chemical resistance. The functionality and the amount of **AFEX™** used will affect the final properties of the polyurethane sealants.

#### **Cross-linking or curing agent for epoxy adhesives and coatings**

**AFEX™** can be reacted with an anhydride and amines to prepare amine-amide curing agents for epoxy based adhesives and coatings. Using specific **AFEX™** products, the conjugated double bond inside the final amine-amide curing agent will carry out additional cross-linking through oxidation to open the double bond. This additional cross-linking will improve the final properties of the adhesive or coating.

#### **Various commercial additives for coatings and adhesives such as thickening, wetting, dispersing agents etc.**

**AFEX™** can be used as part of the OH-containing mixture in the preparation of various additives which are based on either urethane or melamine chemical reaction. The potential oxidation cross-linking reaction of the **AFEX™** modified additive will form a new generation of reactive or cross-linkable additives.

The following are AFEX™ products that can be used as raw materials or additives in the preparation of various products related to polyurethane or melamine reactions such as adhesives, coatings, sealants, foams and composites etc.

Product Name	Average Functionality of OH	Equivalent Weight	Type of Reaction
<b>Base Drying Oil: Tung</b> <i>Three conjugated double bonds</i>			
TG30C	3.0	295	Urethane
TG23C	2.3	148	
TG20C	2.0	199	
TG15C	1.5	354	
TG10C	1.0	664	
TG30L	3.0	295	Melamine
TG23L	2.3	148	
TG20L	2.0	199	
TG15L	1.5	354	
TG10L	1.0	664	
<b>Base Drying Oil: Linseed</b> <i>Two double bonds</i>			
LN30C	3.0	295	Urethane
LN23C	2.3	148	
LN20C	2.0	199	
LN15C	1.5	354	
LN10C	1.0	664	
LN30L	3.0	295	Melamine
LN23L	2.3	148	
LN20L	2.0	199	
LN15L	1.5	354	
LN10L	1.0	664	
<b>Base Semi-Drying Oil: Soybean</b> <i>One double bond</i>			
SB30C	3.0	294	Urethane
SB23C	2.3	148	
SB20C	2.0	200	
SB15C	1.5	356	
SB10C	1.0	667	
SB30L	3.0	294	Melamine
SB23L	2.3	148	
SB20L	2.0	200	
SB15L	1.5	356	
SB10L	1.0	667	
<b>Base Non-Drying Oil: Canola</b> <i>No double bond</i>			
CN30C	3.0	293	Urethane
CN23C	2.3	149	
CN20C	2.0	201	
CN15C	1.5	356	
CN10C	1.0	668	
CN30L	3.0	293	Melamine
CN23L	2.3	149	
CN20L	2.0	201	
CN15L	1.5	356	
CN10L	1.0	668	

<b>Base Non-Drying Oil: Corn</b>			
<i>No double bond</i>			
CR30C	3.0	293	Urethane
CR23C	2.3	149	
CR20C	2.0	201	
CR15C	1.5	356	
CR10C	1.0	668	
CR30L	3.0	293	Melamine
CR23L	2.3	149	
CR20L	2.0	201	
CR15L	1.5	356	
CR10L	1.0	668	
<b>Base Non-Drying Oil: Peanut</b>			
<i>No double bond</i>			
PN30C	3.0	293	Urethane
PN23C	2.3	149	
PN20C	2.0	201	
PN15C	1.5	356	
PN10C	1.0	668	
PN30L	3.0	293	Melamine
PN23L	2.3	149	
PN20L	2.0	201	
PN15L	1.5	356	
PN10L	1.0	668	