penreco

PRODUCT BULLETIN

SAFETY FACTORS
Clear Gel Candle Formulations

Today's candle market is experiencing a tremendous growth due to the increased popularity of and uses for candles. One of the most unique, versatile and attractive candles available is the "clear gel candle." Clear gel candles are available in a combination of sizes and shapes, and may include fragrances and colors, as well as unique design elements. Clear gel candles may also be formulated for a variety of consumer purposes.

Similar to traditional wax candles, clear gel candles are commonly produced from a hydrocarbon base stock. The use of a gelled hydrocarbon base stock provides the additional advantage of transparency. Penreco produces and markets a series of patented gels (US Patent Numbers 5,879,694 6,066,329 5,578,089) for use in the manufacture of clear gel candles under the **Versagel™** brand name. These gels may be custom formulated to incorporate fragrances, finely dispersed decorations, and other active and/or inert components.

While Penreco does not manufacture candles and is not an expert in the field of candle manufacturing, it has, as a service to its customers, prepared a list of factors which should be considered by a candle manufacturer **before** formulating a clear gel candle. Penreco has compiled this list of criteria, which are identified as "Safety Factors," from candle industry data and resources, and internal evaluations of clear gel candle formulations.

This list is not intended to be a comprehensive list of factors to be taken into consideration when formulating a clear gel candle. It also does not eliminate the need for the candle manufacturer to perform strict safety tests concerning the burning and flaming characteristics of any candle.

SAFETY FACTOR LIST

1. Formulation Ingredient - Gel

Penreco sells a series of candle gels under the **Versagel™** brand name. The are formulated with a narrow cut hydrocarbon oil of exceptional safety relative to the flash point. Via the Cleveland Open Cup (COC) method, flash points of 440 °F (ASTM D-92) and sustained burn (fire point) of 500 °F are typical. Penreco also has optimized polymer type and concentration to produce a gel of exceptional clarity and maximized viscosity to resist cold flow of the gel in the container of choice. Each **Versagel™** grade is designed for different fragrance capacity

with **Versagel™ CLP** designed for fragrance loads of 0-3%, **Versagel™ CMP** designed for fragrance loads of 0-5%, and **Versagel™ CHP** grade designed for suspension of ingredients such as glitter, and specialty pigments along with up to 5% fragrance, also depending on the design and shape of the candle, CHP can be made into a free-standing form.

2. Formulation Ingredient – Fragrance

Penreco does not sell fragrances but has developed excellent relationships with several of the leading fragrance companies. Fragrance selection becomes critical as it relates to compatibility or solubility in the gel. Each fragrance is a complex mixture of many aroma chemicals, perhaps 30-50 different chemical ingredients, combined to produce a fragrance in which the polarity of the mixture needs careful consideration.

A fragrance with a non-polar (hydrocarbon compatible) character is required. This non-polar character does not deteriorate the gel strength and has excellent solubility. The second variable in fragrance selection is the fragrance's flash point. Most fragrances have flash points of 140 °F and higher. A most preferred fragrance flash point would be 170 °F or higher. In summary, the fragrance types to most avoid would be polar fragrances with flash points below 170 °F.
A quick, easy and inexpensive check for fragrance polarity can be done with mineral oil. A non-polar fragrance should be 100% soluble (with no separation, cloudiness or haziness) in mineral oil at the following ratios:

25% fragrance / 75% Mineral oil
75% fragrance / 25% Mineral oil

There are three possible scenarios when performing the polarity test:

- **Complete Separation:** After mixing, the blend immediately separates into two layers. This is an indication the fragrance being tested has a large amount of incompatible (polar) components being used. When these types of fragrances are mixed into a Versagel C product, immediate turbidity or cloudiness could be seen or the fragrance could separate from the gel over time. Penreco does not recommend the use of these types of fragrances in gel candles.
- **Cloudiness:** After mixing, the blend becomes cloudy, but sometimes will turn clear when exposed to elevated temperatures. This in an indication that the fragrance being tested has some incompatible (polar) components that are insoluble in mineral oil. When these slightly soluble fragrances are mixed into a Versagel C product, they may produce a clear gel; however over time they will turn cloudy and separate from the gel.. The time it will take for the mixture to turn cloudy cannot be predicted. This may occur within days, weeks or months, depending on the actual fragrance ingredients, their concentrations and environmental conditions. Penreco does not recommend the use of these types of fragrances in gel candles.

- **Completely Clear:** After mixing, the blend remains completely clear with no separation. This is an indication that the fragrance is completely soluble in the gel. These fragrances are generally classified as non-polar, an are recommended for use in a Versagel C product.

3. Formulation Ingredient - Dyes

No information has been found which shows that the dye influences candle safety, typically because such low amounts of dye are used.

4. Formulation Processing or Mixing

When processing the **Versagel™** candle gel series, Penreco has insured that the polymer concentration is uniform throughout the gel. Care must be taken in not only selecting the correct fragrance but also in completely and uniformly mixing the fragrance into the gel before packaging the gel into the container. Incomplete mixing of the fragrance can cause high concentrations of fragrance within the gel matrix potentially causing irregularly burn characteristics, such as high flames or sooting.

5. Gel Candle Wicks

Penreco does not sell wicks or make wick size recommendations for final consumer packages. We believe the slower burn rate of gelled candle technology (perhaps 40-50% slower than wax) may, unfortunately, encourage manufacturers to use “oversized” wicks.

Prewicked wick systems are available with the wick attached to a 20mm metal clip. Penreco does recommend at least a minimum ¼ inch wick collar. Wick sizes are diverse and must be test burned by the manufacturer to make sure they work with the gel and additive combination. Different sized containers and additive combinations (colors, specialty pigments, fragrance load, etc.) can affect how the candle will burn. These wicks and tabs can be manufactured to any length and wick size up to 2mm in thickness including the wax coating. Generally zinc core wicks are used due to their rigidity during manufacturing and burning, however cotton and paper core wicks can be used. Additionally, cotton and paper core wicks are being evaluated and modified for use in gel candles. Penreco supports the Consumer Product Safety Commission ban on the use of lead core wicks in any candle.

Wick length and placement are important details that can contribute to candle safety. Penreco does not recommend the use of multiple wicks in gel candles. Wicks not trimmed to less than 1/4 inch creates a potential for a very large flame with non-uniform combustion, which, when not centered properly, can create localized overheating of the container and "pool". Such conditions can cause uneven temperature dissipation, a potentially unsafe condition.

There are a number of suppliers that offer sample sets to candle manufacturers for their use in determining the best wick for their specific application for about $25, including Atkins & Pearce, Inc (Covington, KY. Ph. (606) 356-2001).

6. Gel Candle Containers

Penreco has studied and burned countless experimental candles in containers, jars, glasses, and mugs of different sizes and shapes. As mentioned in the wick choice, the characteristics of the "pool viscosity" and pool temperature are influenced by the wick size and container selection. Container diameter will influence "pool temperature" and can hinder the safe dissipation of generated heat. The container also becomes important at the end of the burn cycle during the burning of the last few grams of candle gel. Because gel candles burn hotter than wax candles, container composition (glass, tempered glass, clay, etc.), container center of gravity and base stability, and container diameter are all factors to be considered.

7. Gel Candle Consumer Use Instructions:

Penreco feels proper consumer education to also be an important aspect of gel candle safety. Safety points are as follows:

1. Never leave a burning candle unattended.
2. Never burn for more than four hours.
3. Always trim wick to ¼" above the gel surface before each use.
4. Never burn the last inch of a candle.
5. Keep candles out of reach of children and pets
6. Keep candles away from drafts, vents and flammable objects.
7. Keep matches and other debris out of the candle
8. Do not move a glass container candle when candle is burning and/or the gel is liquid
9. Extinguish the flame if it burns too close to the container walls
10. Extinguish a candle that smokes (check instructions before re-lighting)

In summary, we have attempted to identify key safety factors. However, this report should not be construed by the manufacturer as license to bypass clear and decisive safety testing of all variables before launch.

For more information see www.penreco.com

Penreco makes no warranties , expressed or implied, as to the suitability of Versagel™ C gelled hydrocarbons for use in secondary products or the actual results of its use in any such products. Penreco expressly disclaims and all all liability resulting from the use of this product in any secondary products produced thereby.