

Abstract

An environmental assessment is required for all new tobacco products that apply for market authorization in the USA. This assessment includes determining the impact of manufacturing, use, and disposal of the product on the environment. A new category of pouched tobacco products generally known as modern oral nicotine products has become popular. They do not contain any tobacco leaf material and are generally made with cellulose, binders, flavors, and nicotine. The granular material is enclosed in a fleece pouch, similar to a tea bag, also usually cellulose based. The consumer places the pouch between the lip and gum for buccal absorption of the nicotine which releases through the pouch membrane over time. After the pouch is depleted, the consumer is instructed to dispose of the used pouch in the trash. Reasonable worst case disposal scenarios were modeled to evaluate if a used pouch was to be disposed of in publicly owned wastewater treatment systems, in home septic systems, or as litter on the ground. Additional potential releases of nicotine to the environment during product use from human excretion were also modeled. The FDA approach established for human drugs and biologics was applied to quantify the anticipated effect of residual nicotine in the pouch on the environment. The calculations compared the Expected Introduction Concentration to the established de minimis concentration of 1 microgram per liter or 1 part per billion. The results of the various worst case scenario calculations showed the estimated nicotine concentrations are not expected to exceed the de minimis threshold under any of the scenarios and therefore the use and disposal of the product is not likely to significantly impact the environment.

Introduction

A PMTA must contain an environmental assessment (EA) prepared in accordance with § 25.40. Failure to include an EA in a PMTA is grounds for FDA to refuse to accept an application and failure to include an adequate EA is sufficient grounds under § 25.15 for FDA to refuse to file the PMTA or refuse to issue a marketing granted order. Among other things, the EA must include the relevant environmental issues relating to the use and disposal of the tobacco product.

Background

A new category of pouched tobacco products generally known as modern oral nicotine products has become popular (**Figure 1**). They do not contain any tobacco leaf material and are generally made with cellulose, binders, flavors, and nicotine. The powder material is enclosed in a fleece pouch. The consumer places the pouch between the lip and gum for buccal absorption of the nicotine. After the pouch is depleted, the consumer is instructed to dispose of the used pouch in the trash. Pouches routinely contain between 3 and 12 mg of nicotine,

Figure 1. Modern Oral Nicotine Pouch



Scenarios

The approach the FDA established for human drugs and biologics was applied to quantify the anticipated effect of the estimated nicotine content of the pouch on the environment. Aquatic and terrestrial scenarios were developed to evaluate the potential impact disposal of a used pouch. One of the major concerns was the potential effect of disposal of a used pouch in a toilet and also excreted urine containing nicotine on public sewer and private septic systems. Another concern was littering of the pouch on the ground and migration to surface waters of direct littering in surface waters. Terrestrial scenarios included application of sewer sludge to land and direct littering on land. The aquatic expected environmental concentration (EIC) calculations were compared to the established de minimis concentration of 1 microgram per liter or 1 part per billion (1 µg/L or 1 ppb). The Terrestrial EIC values were then compared to the de minimis threshold of 100 ppb or 100 µg/kg (0.1 ppm) provided by the FDA's Guidance for Industry: Environmental Impact Assessments (EIAs) for Veterinary Medicinal Products (VMPs) – Phase I. The FDA states this value is below the level shown to have effects in ecotoxicity studies conducted on earthworms, microbes, and plants, with VMPs currently registered in the U.S. Therefore, any Terrestrial EIC's calculated for nicotine that fall below the 100 µg/kg (0.1 mg/kg) terrestrial threshold are not considered being at a level of concern to have significant impact to the environment. The FDA's rationale for selecting a predicted environmental concentration (PEC) in soils at 100 µg/kg is based on an analysis by an AHI Environmental Risk Assessment Working Group.

Assumptions

- EPI Suite™ software was used to predict nicotine physical/ chemical properties and environmental fate estimates in aquatic and terrestrial environments (United States Environmental Protection Agency 2012).
- The pouch contains 12 mg of nicotine and there are 20 pouches in a can;
- 20% of nicotine remains in pouch after use (based on dissolution testing);
- The pouch has value to the consumer and is unlikely to be littered in its un-used state;
- Nicotine is the chemical of ecological concern in the pouch;
- The kg/year produced is based on the highest quantity of pouches expected to be marketed in the U.S. during the next five years;
- All of the nicotine from the pouches is expected to be consumed in a year and enter the POTW (the nicotine within the pouch is absorbed by the human body during use and 100% of the ingredient is then excreted to sanitary sewers and to the POTW);
- There is no metabolism of the nicotine (no conversion of the substance within the human body);
- There is no metabolism of the nicotine in sludge;
- The New Product's usage occurs throughout the United States in proportion to the population.

References:
AHI Environmental Risk Assessment Working Group, 1997, Analysis Of Data And Information To Support A PEC soil Trigger Value For Phase I (A retrospective review of ecotoxicity data from environmental assessments submitted to FDA/CVM to support the approval of veterinary drug products in the United States from 1973-1997).
Emily Godfrey, 2004. "Screening Level Study of Pharmaceuticals in Septic Tanks, Ground Water, and Surface Water in Missoula, Montana." The University of Montana. <https://scholarworks.umt.edu/etd/3492>.
Seckar, Joel A., Mari S. Stavanja, Paul R. Harp, Yongsheng Yi, Charles D. Garner, and Jon Doi. 2008. "Environmental Fate and Effects of Nicotine Released during Cigarette Production." *Environmental Toxicology and Chemistry* 27 (7): 1505–14. <https://doi.org/10.1897/07-284.1>.
United States Environmental Protection Agency. 2012. "Estimation Programs Interface Suite™ for Microsoft® Windows." Washington, DC.

Aquatic Scenario Results

- Human Excretion of Annual Market Volume to POTWS** - the estimated nicotine concentration is not expected to exceed the de minimis threshold under this scenario.

Maximum Projected U.S. Annual Market Volume (pouches)	Estimated Nicotine Consumed and Excreted (mg/pouch)	Estimated Nicotine per year (kg)	Maximum EIC – Aquatic (µg/L)
7560000	9.6	725.76	0.01508461

- Human Excretion of Annual Market Volume to Septic Tanks** - the estimated nicotine concentration in a 70 gallon per day septic tank is not expected to exceed the de minimis threshold under this scenario.

Maximum Projected U.S. Annual Market Volume (pouches)	Estimated Nicotine Consumed and Excreted (mg/pouch)	Estimated Nicotine per year (kg)	Maximum EIC – Aquatic (µg/L)
7560000	9.6	725.76	0.00234479

- Used Pouch discarded in Septic Tank** – the EIC is calculated dividing the amount of nicotine in a used pouch (2.4 mg) by the estimated daily volume load of wastewater to a home septic system in a typical US household. The calculated **EIC is 3.4 µg/L**, exceeding the de minimis threshold of 1 µg/L. The EIC value assumes that there is no treatment or degradation of nicotine in the septic tank or drain field. Studies on septic systems indicate that treatment and degradation does occur (Emily Godfrey 2004)
- Incidental Exposure (Based on One “Used Pouch”) to Ground or Surface Water)** – this assumes a used pouch is littered on the ground with eventual migration to surface water. Nicotine has been shown to be biodegradable in both water and soil. Exposure of a used pouch directly to surface water would experience immediate dilution of residual nicotine and the resulting low concentrations would not be expected to harm aquatic organisms. **The dilution effect will mitigate any potential hazards to the aquatic environment.**

Terrestrial Scenario Results

- Application of POTW sewage sludge (biosolids) to land** – this assumes a maximum volume of pouches goes to POTW, and that 1.5% will absorb to sewage sludge. The estimated terrestrial **EIC of 0.00094 mg/kg** is less than FDA's de minimis concentration of 0.1 mg/kg indicating that application of sewage sludge will not likely present an ecological toxicity hazard.

Maximum Projected Volume (Pouches)	Estimated Nicotine Content (kg/yr)	Maximum EIC-Terrestrial (mg/kg)
7560000	10.886	0.00094

- Incidental Exposure from littering a single used pouch to the ground** – this assumes a consumer throws a used pouch on the ground. The terrestrial EIC is based on one used pouch being thrown where it is exposed to soils with a surface area of one square foot (0.09 m²), with a vertical depth of 6 inches in soil (0.152 meters) and a density of 2.65 g/cm³. The **terrestrial EIC** is estimated to be **0.00001 mg/kg, less than the de minimis value.**

Conclusions

Model scenarios suggest that disposal of used pouches is unlikely to produce aquatic or terrestrial ecological hazards.