

Making soy-based crayons

How might we create a better crayon?

Investments in research by the soybean industry have enabled important innovations. One of these innovations is the soy crayon. Crayons have traditionally been made with petroleum-based paraffin wax. In 1993, two students at Purdue University created soy crayons as their entry in a Soybean Innovation contest. Dixon-Ticonderoga purchased the rights to the production process of soy crayons. In 1997, the first soy crayons were introduced. These crayons are made of 85% soybean oil through a hydrogenation process turning the oil into a soft wax. Hydrogenated soybean oil has been processed by adding hydrogen to make it more saturated. Hydrogenation increases the oil's stability and raises its melting point so that it is a solid at room temperature. Per USDA Weights and Measures division, a 60-pound bushel of soybeans yields about 48 pounds of protein-rich meal and 11 pounds of oil. The soybean oil from one bushel of soybeans will make approximately 2,112 crayons.

Challenge

Ohio soybean farmers contribute funds, known as the soybean checkoff to invest in areas that help drive innovation and build understanding to ensure the future success of the soybean industry. As Material Science Engineer Interns, your team has received a grant funded by these checkoff dollar contributions. The purpose of the grant is to apply scientific and engineering practices to create a box of four nontoxic, bio-based crayons made from soy wax and other sustainable materials to use in local elementary schools across Ohio.

Materials

- soy wax (flakes)
- other natural wax flakes: beeswax, carnauba, coconut, cocoa butter
- colorants (turmeric, beet powder, spirulina, mica powders)
- scoops
- beaker (100-250mL)
- weigh boats
- silicone molds
- electronic balance
- hot plate
- magnetic stir bars

Procedure

Part 1: Product Design and Development

Using the following constraints, design and develop 50g of a nontoxic bio-based crayon mixture to produce four crayons in the given mold:

1. 85% soy wax
2. 15% other natural wax/oils
3. Natural colorant needs to be used such as algae powder, mica powder, spices, etc.

Note: make sure to show breakdown of amounts of materials used to make the product

Complete the table with all ingredients of the crayon formula including name of ingredient, amount of ingredient needed and amount of ingredient actually measured. Record date and initials for each ingredient after it is added to the media prep log.

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Media Prep Log

Ingredient	Amount of ingredient needed (ÜL, mL or g)	Actual mass of ingredient	Added	Date	Tech Initials

Special Notes/Calculations/Conversions:

Part 2: Product Testing

Complete these engineering design product tests

1. 3-Point Bend Test (see activity page)
2. Strength Test (see activity page)
3. Melt Point (see activity page)

Complete the art preference test

1. Smudge Test (see activity page)