

How Crayola Crayons Are Manufactured

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November 10, 2019

MEEG453: Self Selected Homework #7

Summary: This report contains a description on the manufacturing process of a Crayon. A brief history is discussed how the current crayon design has evolved. Followed by an overview of the general manufacturing and materials required to produce a crayon. Along with the transportation and material handling used throughout the system. This report also covers the economics and engineering relevance for beginning and experienced engineers to mass producing crayons.

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Main Body

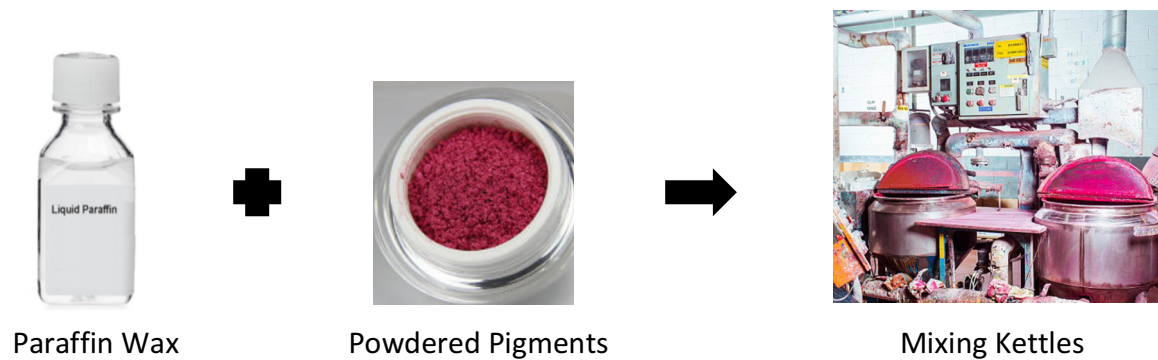
History:

Crayons were originally created in Europe and made out of charcoal and oil. This design was used, but there were many flaws from the material makeup that caused brittleness and a overall mess. No one wants to go and draw and have their crayon break on them or pick up a crayon and it get all over your hands instead of just the paper. Although Crayola did not invent this product; in 1903 they revitalized it. Binney and Smith's company designed and created the crayons we all use today. Which have become a huge success throughout the world. Inspiration from teacher's complaints drove these men to success, allowing them to create this wax and powered pigment mixture into a crayon. This combination created a sturdier, non-toxic, non-brittle crayon with colorful options. The stick design with a pointy tip was made small enough for a child's hand and strong enough for the forces being exerted upon it when in use. Allowing children to make colorful creations on their paper with little to no mess. This Crayon revolutionized the art within the classrooms and homes that we all know and love today. Today the crayon has skyrocketed and new designs have been created since 1903, there are twistable crayons that don't require sharpening and crayons that even are erasable. Although, as high tech these new crayons might be the original crayon from Crayola holds true and is still widely used. This company was able to take this industry to a new level allowing children to use their imaginations in a neat way; while aiding in the classrooms worldwide.

Manufacturing Process:

Crayons are made from a mixture of paraffin wax and chemical pigments. These pigments are used in a powdered form since paraffin does not mix well with water. When the pigments are added they supply the vibrant colors to the colorless wax. When creating the pigments, they were originally liquid form that was dried and made into the powdered form for the crayon facilities. While the paraffin is delivered to the factories in liquid form; within railcars that maintain a proper temperature to not allow the wax to harden. It is important throughout this process to maintain the paraffin in the liquid state during transportation to allow for sufficient mixing to create a successful crayon. Along with these two main ingredients some additives are also used to increase the overall strength of the crayon.

When these materials arrive to the factories, the wax is melted further and stored in silos until ready for use. When the wax is ready for manufacturing they transport it through a heated pipe system into large mixing kettles. At the kettles the pigments and additives are added to give the wax its color and is completely blended together. At larger factories they typically have many kettles running creating multiple colored crayons at once on separate manufacturing lines.



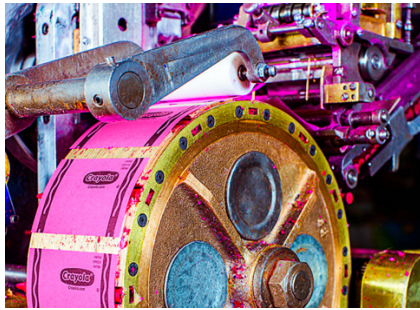
From here the mixture is then pumped from the kettles through tubes into a rotary mold. The crayon molds are typically over filled to ensure each cavity is completely filled, and then the excess material is scraped off the top of the mold. Then they allow the mold to sit and cool, for the crayons to harden into the popper crayon shape. Different pigments take different amounts of time to harden ranging from approximately 4-7 minutes. When hardening is complete the crayons are ejected from the mold into a robotic arm. Where they are carried to the labeling stations. This mold system is typically on a rotary machine where the molds are being filled a section at a time. Allowing for one part to cool, while another section can be filled. This continuous process allows for a smooth transition between stages of filling, cooling, and ejecting.



Labeling/Packaging Process

When the crayons arrive to the labeling stations they are fed into a big metal drum. The large roll of labels rotates as it sticks on the adhesive and label around the molded crayon. The crayon is spun to completely wrap the label around it. From there the crayons go through an inspection. This quality check is used to ensure uniformity of the crayon tips and that the crayons mold was completely filled properly, or to remove any crayons that have broken along

the way. Once this step is completed the crayons are placed in these hoppers by color. The hoppers dispense one color of each crayon slowly down into an organized fashion.

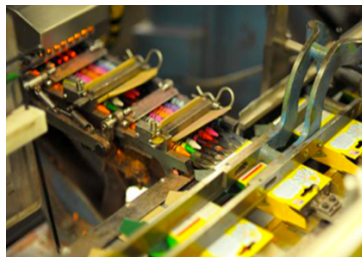


Crayon Labeler



Crayon Hopper

From here one of each color crayon is neatly fed into a container. Then the crayon box is formed around this arrangement. The bottom of the box is then folded and sealed shut to keep the crayons from falling out. Allowing the crayon box to be complete. These boxes then travel along a conveyor belt and are placed in another box and are ready for shipping.



Boxing the
Crayons



Traveling on a
Conveyor belt



Ready for
shipping

Economic and Business Aspects

Crayons are being manufactured each and every day. Crayola alone produces 3 billion crayons a year. Selling a typical box of 8 crayons at \$1.50 a box. This high volume item is sold as a low cost product. Due to the mass production, few materials required to create, and minimal manufacturing steps required to produce approximately 12 million a day, allows for this low purchasing price. This technique of making many crayons at once has allowed this company to become extremely successful; while producing a product people love and are willing to pay for at such a low price. Since 1903, this once manual process has become completely automated. Due to advancements in technology they were able to go from mixing the wax and pigments by hand and physically pouring them into the mold to a highly machined process. Interestingly though the one process that has not been transferred to automation is the quality check. It is

still completed by human eyes to look and remove any crayons that don't meet the proper standards of a crayon. This has been deemed a sufficient enough process thus far and has allowed the company to still be successful and deliver proper crayons to their customers. Ultimately, allowing them to increase production per day and overall per year tremendously.

Relevance for Beginning and Experienced Engineer

The significance of this topic for a beginning engineer is to recognize the significance of the process of making a crayon is to understand the general material handling and manufacturing of a simple product that is used widely. Generally, to make sure they know the overall engineering principals that go into creating this product and the steps required in doing so.

The significance of this topic for an experienced engineer should be focusing more on on the specific engineering principals that apply to this system. For example, having a complete understanding of fluid flow through the mold, proper force exertion of the crayon from the mold with out fracture, and heating of the paraffin throughout the entire system to ensure it does not harden until it reaches the molds. These are important aspects that can allow experienced engineers to use these techniques and their full understanding of this process to make the proper improvements throughout the overall system. While ensuring quality control and little variance throughout each batch of crayons created.

Learned

Through this project, I have learned about the process to manufacture crayons at a high quantity and quality. Being able to understand the many steps required to produce this product from proper mixing, to entering the mold and hardening, to being transferred to be labeled and boxed. Although simple, I believed it was interesting to see the amount of automation required to produce such a simplistic colorful stick a child uses for art purposes. As a crafty person myself I was interested in finding out how this box of crayons was produced, something I never considered or put much thought into. Though I was taken back by the amount of steps required to make such a product. The thing that mostly intrigued me was the highly automated labeling system. It was really interesting reading and watching videos how this process occurred. I realized the complexity required for the transferring of the crayon and quick rotation without breaking; while wrapping a piece of paper around it was ultimately effortless. Overall, I have learned that this process to produce a crayon is more complex then I originally believed.

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