Turning Car Soot into Permanent Ink

Bogar, J., Dela Cruz, M., Dolotina, L., Duma, P., Quijano T.

ladolotina@hnu.edu.ph
Pasig City Sciemce High School, F. Legaspi St. Rainforest Park, Maybunga, Pasig City, Philippines, 1600

Abstract

This research aims to give new knowledge of new materials specifically permanent ink. Researchers are developing ink from car soot which is very significant and very useful to our daily lives but some instances can affect our research. This research also aims to provide people with an affordable permanent marker. By pursuing this research and helping the researchers, it will help the environment lessen air pollution which is one of the major problems worldwide. In making the marker, the researchers must find all the parts of the marker needed. Most importantly the researchers are obliged to collect all soot as much as possible and produce ethanol that is proportional to the soot. As expected in this research, the researchers must produce permanent markers which the researchers did. The permanent marker resulted in good opacity and a good result in the air-dry test. The rougher the paper, the more it consumes time to make the ink completely dry and cannot be removed by rubbing it. This research produces an affordable and eco-friendly permanent marker.

Keywords: Car Soot; Permanent Ink; Soot; Air Pollution

INTRODUCTION

1. Background of the Study

Today, People experience serious health risks and environmental damage. Pollution is the main cause of it. Soot, the word “soot” sounds so simple but not harmless. Soot is anything but simple yet it is certainly not harmless. When interacting between soot and flow of the phenomena in terms of flames, and fundamentals of the mechanism of soot when it comes to formation, oxidation, and nucleation, compared to the gaseous combustion of products, soot exhibits unusual effects. Soot has a small mass diffusion of velocities. Soot includes fine black particles, composed of carbon and it is produced by incomplete combustion of coal, oil, wood, or other fuels, it may also contain acids. Soot particles are extremely tiny 2.5 micrometres smaller in diameter. It is smaller than dust or mold. This is what makes it interesting because soot is suitable for having a good side when ink will benefit a lot. In making permanent ink, solvent is the key. This liquid carrier is needed to dissolve the ink colorant and resin to pass through the siphoning so that it will produce ink. Ink solvents should be non-polar like xylene, of

course, people discovered something that can be suitable for kids. Once this liquid ink is applied to the paper, the solvent will evaporate into the air leaving only the colorant and resin. If we settle for this research, this can help our environment to lessen its damage because the things researchers do are eco-friendly. When it comes to finances, for getting soot there would be no money involved because it's a waste and people know that soot is a waste and one problem of our society worldwide. In terms of its size and its toxic composition, even though soot is dangerous. It that can be turned into something useful.

1.1 Statement of the Problem

Researchers are developing ink from car soot which is very significant and very useful to our daily lives. However, some instances can affect our research.

1.1.1 MAJOR PROBLEM

Is soot suitable for making a permanent marker that comes from a processed carbon-based pigment?

1.1.2 MINOR PROBLEM

Air Dry and Opacity of the Ink. The correct formulation of the ink.

1.3 Hypothesis

Using black car soot can be processed to be a carbon-based pigment for making permanent ink.

1.4 Significance of the Study

The result of the study will lead people to get and afford a permanent marker and help the researchers get more soot and produce lots of markers. This study will benefit the environment by collecting soot that can cause air pollution which harms the environment. If the researchers collect a lot of soot, it can lessen the pollution. Air pollution is one of the major problems in the world because it will continuously harm the environment if we do not avoid burning specific fuels and if we continue to smoke. This study will also help the students so that they will not be obliged to buy expensive permanent markers. This study will lead the researchers to make cheaper markers that can be used by society.

1.5 Scope and Limitation

This study is about the use of Car soot to make a permanent ink with the correct formulation. The researchers will collect the car soot by using a can. Due to time constraints, the researchers will only mix the collected car soot with the binder. To test the ink is to know if the viscosity of the ink is correct.

1.6 Definition of Terms

Lubricant - is a substance that is used to control (more often to reduce) friction and wear of the surfaces in contact with the bodies in relative motion. Depending on their nature, lubricants are also used to eliminate heat and wear debris, supply additives into the contact, transmit power, protect, and seal. A lubricant can be in liquid (oil, water, etc.), solid (graphite, graphene, molybdenum disulfide), gaseous (air), or even semisolid (grease) forms. Most of the lubricants contain additives (5-30%) to improve their performance.

Solubilizers - When something is soluble it means it can be dissolved in water. Solubilizers as they relate to making cosmetics, help to make otherwise insoluble liquids soluble in water. Solubilizers are way too different from emulsifiers.

Surfactants - Surfactants are one of many different compounds that make up a detergent. They are added to remove dirt from skin, clothes, and household articles, particularly in kitchens and bathrooms. They are also used extensively in industry. The term surfactant comes from the words surface active agent.

Particulate matter - is the sum of all solid and liquid particles suspended in air many of which are hazardous. This complex mixture includes both organic and inorganic particles, such as dust, pollen, soot, smoke, and liquid droplets.

Fluorescent - surface, substance, or color has a very bright appearance when light is directed onto it as if it is shining itself.

Adhesion - the action or process of adhering to a surface or object; an abnormal union of membranous surfaces due to inflammation or injury.

Fir - an evergreen coniferous tree with upright cones and flat needle-shaped leaves, typically arranged in two rows. Firs are an important source of timber and resins.

Oxidation - the process or result of oxidizing or being oxidized. Oxidation is the loss of electrons during a reaction by a molecule, atom, or ion.

Diffusion - process resulting from random motion of molecules by which there is a net flow of matter from a region of high concentration to a region of low concentration. A familiar example is the perfume of a flower that quickly permeates the still air of a room.

Nonpolar - is a type of chemical bond that exists between two atoms. This bond is formed when electrons are equally shared between two atoms (usually nonmetals belong to the p-block in the periodic table). These bonds can be either formed between two identical atoms or between different atoms. It is termed as nonpolar because the difference in electronegativity (tendency to accept bond pair of electrons towards itself) is negligible. Hence there is an absence of the separation of charges between the two atoms.

Polyesters - Polyesters are polymers formed from a dicarboxylic acid and a diol. They have many uses, depending on how they have been produced and the resulting orientation of the polymer chains.

REVIEW OF RELATED LITERATURE

1. Car Soot

Soot is a black powdery or flaky substance consisting largely of amorphous carbon, produced by the incomplete burning of organic matter. Car is one of the most popular kinds of transportation in the world and a lot of people owned one or more. This car releases smoke which affects the environment, but there are a lot of ways that can be used to prevent the destruction of our environment and make all these bad substances useful in our society. Cars need to use fuel to operate. When the fuel burns in the piston of the engine, it releases the same kind of waste products. One of the waste products that will be released by the engine is carbon dioxide and this carbon dioxide will be the waste material (soot).

2. Permanent Ink

Permanent ink is used to create permanent or semi-permanent writing on an object. It's also used in daily life mostly with students, office workers, and many more because it is much convenient and trustworthy to use instead of using pencils that need to have a sharpener just to use but in inks you just wait until it is empty. There are different types of permanent ink for example ballpoint pen ink, drawing pen ink, fountain pen ink, rollerball pen ink, and gel pen ink. First is ballpoint pen ink. It is an ink containing oil-based solvent and pigment for color. Second is drawing pen ink an ink for drawings. It is water-based and contains dye rather than pigment for colors. Third is the fountain pen ink like drawing ink, but has a refillable cartridge that holds a small quantity of fountain pen ink which eliminates the need for dipping the pen in ink. Fountain pen ink is water-based and contains dye for color, but also contains a surfactant that controls the flow of ink when the nib comes in contact with the paper. Fourth the rollerball pen ink is water-based or gelled and requires less pressure on the rollerball tip to write. The last one is gel pen ink which contains colorful pigment suspended in a thick, water-based gel. The ink comes composed of solvents, pigments, dyes, resins, lubricants, solubilizers, surfactants, particulate matter, fluorescents, and other materials.

3. Permanent Marker

All permanent markers are, essentially, hollow plastic tube that is airtight, save for a single opening at one end. This tube encases a long stick of porous, sponge-like material, which protrudes slightly out of the opening (the tip of the marker). There is an absorbent inside the tube that is saturated with ink. When Ink dries or evaporates, a siphoning effect draws ink inside the

tube. Permanent marker ink is composed of three elements: a colorant, a solvent, and a resin. The pigment dye or colorant gives the idea of color. Whether black, blue, red, neon yellow, pink or any other hue, the colorant is what you see when you look at a line made by a permanent marker. The main difference between dyes and pigments is that dyes are water-soluble while pigments are generally insoluble in water or non-polar solvents unless the pigment is ground into very, very fine powder. Then, one of the most important thoughts in making this is the solvent. Mainly, people now used markers and used xylene as a solvent but it switched to a less toxic alcohol. The solvent automatically evaporates and leaves solvent resin only. Resin is a glue-like polymer; ink resin ensures that ink colorant "sticks" to paper once the solvent evaporates. The biggest difference between permanent and non-permanent markers lies in the ink resin.

3.1 Exhausts

A car exhaust system reduces the emissions of a car by releasing them through the pipe. It is carefully designed to carry the toxic green gases away from the engine. It releases exhaust gases such as hydrocarbons, carbon monoxide, and nitrogen oxides. It consists of the burned gases and particulates that are created by the engine Exhaust gases leave the engine under extremely high pressure. It frees up some power in your engine for a quicker and more efficient path for exhaust gases to escape. It allows the engine to breathe better to create more smoke. It controls noise and directs exhaust fumes away from the passengers. It also releases black smoke that is caused by burning too much fuel that can be checked through the air filter or clogged fuel. Black smoke is usually easy to fix but burning unnecessary fuel can affect the fuel economy

3.2 Solvent (Ethanol)

Ethanol is naturally produced by the fermentation of sugars by yeasts. Ethanol is flammable and volatile. It’s a colorless liquid with a slight characteristic odor. It also has medical applications as an antiseptic and disinfectant Ethanol is widely used as a chemical solvent.

CONCEPTUAL FRAMEWORK

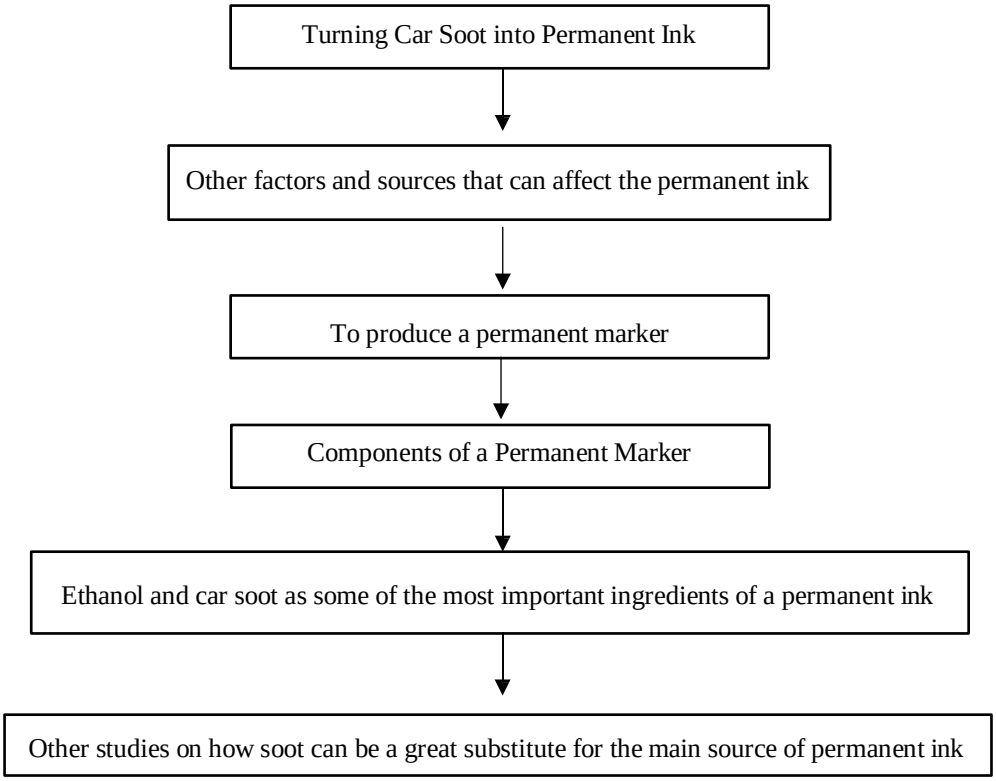

Fig 1. Conceptual Framework for making the marker

Materials and Methods

MATERIALS	QUANTITY
Car Soot	5tbsp
Solvent (Ethanol)	500 ml
Siphon	1 pc
Container of the ink	1pc
Container of the soot	1 pc
Carver	1 pc
Large Bowl	1 pc
Gloves	6 pairs

Polyester	1pc
Plug	1pc
Body	1pc
Wadding	1pc
Tip	1pc

Table 1. (a) left column indicate the materials needed (b) right column indicate how much materials needed per material

Procedure

1. Gather all the materials

- All the materials must be ready and cleaned

- Everything has to be ready to be used

2. Sanitize the gloves

- Since it is a collection of waste material, the researchers need to use gloves for protection and sanitary purposes

3. Get the carver and carve all the soot from the exhaust.

- The soot sticks in the exhaust, then a carver must be used

4. Place the carved soot in the large bowl (5 tbsp of car soot) - The soot collected is already ready for the mixing part.

5. Provide or get an ethanol (500 mL)

- The ethanol or the solvent is needed for this procedure

6. Mix the ethanol with the carved soot. (50 mL of Ethanol and 5tbsp of Car soot)

- Solvent will dissolve the solute

7. Transfer the final mixture to the polyester

- The final product (ink) is transferred in the polyester for the tests

8. Combine the ink-filled polyester and assemble its parts to form the marker.

- The ink is ready to be used (3.5mL of Ink)

- The tests will be done by using the end product

Different Types of Writing Surface

Table 2 – 3.5 mL of Ink (Bond paper)

Air Dry	Opacity
Trial 1: 24.70 seconds	Matte Black
Trial 2: 19.45 seconds	Matte Black
Trial 3: 26.86 seconds	Matte Black

Table 2: Shows the following results of the ink when applied to the Bond Paper. The table shows the time for each trial. Every trial still has the same opacity based on observations.

Table 3 – 3.5 mL of Ink (Oslo Paper)

Air Dry	Opacity
Trial 1: 31.79 seconds	Matte Black
Trial 2: 29.11 seconds	Matte Black
Trial 3: 34.04 seconds	Matte Black

Table 3: Shows the following results of the ink when applied to the Oslo Paper. The table shows the time taken to dry the ink. Each trial still has the same opacity based on observations of the researchers.

Table 4 – 3.5 mL of Ink (Manila Paper)

Air Dry	Opacity
Trial 1: 9.28 seconds	Matte Black
Trial 2: 12.22 seconds	Matte Black
Trial 3: 9.88 seconds	Matte Black

Table 4: Shows the following results of the ink when applied to the Manila paper. The table shows the results of the air-dry test. The opacity remains the same based on observations.

Table 5 – 3.5 mL of Ink (Watercolor paper)

Air Dry	Opacity
Trial 1: 28.09 seconds	Matte Black
Trial 2: 27.86 seconds	Matte Black
Trial 3: 18.32 seconds	Matte Black

Table 5: Shows the following results of the ink when applied to the Watercolor paper. Every trial show that the opacity remains consistent.

Table 6 – 3.5 mL of Ink (Illustration Board)

Air Dry	Opacity
Trial 1: 15.58 seconds	Matte Black
Trial 2: 18.61 seconds	Matte Black
Trial 3: 16.79 seconds	Matte Black

Table 6: Shows the results of the ink when applied to the illustration board. The table shows the results of every trial. The Table shows that the opacity remains the same.

DATA TABLE

3.5 mL of Ink	**50 mL of Ethanol**	**5tbsp. of car soot**

DATA ANALYSIS

Type of paper used	**Air Dry**	**Opacity**	**Trials**
Bond Paper	Mean: 23.69 Sd=3.81	Matte Black	1st – 3rd
Oslo Paper	Mean: 31.65 Sd=38.81	Matte Black	1st – 3rd
Manila Paper	Mean: 10.46 Sd=1.55	Matte Black	1st – 3rd
Water color Paper	Mean: 24.76 Sd=5.58	Matte Black	1st – 3rd
Illustration Board	Mean: 16.993 Sd=1.53	Matte Black	1st – 3rd

Findings, Data, Results

The following tables present the opacity and air-dry test of the ink. The researchers came up with these tables according to the results and findings of the experiment. In table A, the marker contains 3.5 mL of ink and it was written on a bond paper. The table shows the result of the air-dry test and the opacity remains the same based on observation. In Table B, the marker contains 3.5 mL of ink and it was written on oslo paper. The table shows the time taken to dry the ink. Each trial still has the same opacity based on observation. In table C, the marker contains 3.5 mL of ink and it was written on a manila paper. The table shows the results of the air-dry test. The opacity remains the same based on observations. In Table D, the

marker contains 3.5 mL of ink and it was written on a water color paper. The table shows that the opacity of the ink is still the same. Lastly, in Table E, the marker contains 3.5 mL of ink and it was written on an illustration board. The table shows the results of every trial. The Table shows that the opacity remains the same. These results are gathered during and after the experiment. In terms of the Air-dry test of the ink. Based on the observations of the researchers, the rougher the paper, the more it consumes time to make the ink completely dry and cannot be removed by rubbing it. The manila paper has the smoothest texture and the table above shows that this paper has the lowest time consumed in making the ink dry.

Recommendations

Since this project has car soot, the researcher must have different sources of cars and different types of exhausts. This will help the researchers to collect enough amount of car soot for the marker to be done. In terms of the marker container that will contain the ink. It must be clean or the researchers must buy an empty maker container because this will be easier to transfer the ink than recycling the used maker container.

References

Environmental Protection Agency (2017, November 14) EPA. Particulate Matter (PM). Retrieved from November 19, 2016, https://www.epa.gov/pm-pollution/particulate-matter-pm-basics

Retseck G. (2015, May 14) Scientific American. Chromatography: Be a Color Detective. Retrieved from November 19, 2018, https://www.scientificamerican.com/article/chromatography-be-a-colordetective/

Science for a Healthy World and Safer World (2018, July 19). Cars, Trucks, Buses and Air Pollution. Union of Concerned Scientists. Retrieved from November 19, 2018, https://www.ucsusa.org/clean-vehicles/vehiclesair...and.../cars-trucks-air-pollution

The Editors of Encyclopedia Britannica. (2016, April 11). Resin. Encyclopedia Britannica. Retrieved from November 19, 2018, https://www.britannica.com/science/resin

The Editors of Encyclopedia Britannica. (2018, March 1). Melamine formaldehyde resin. Encyclopedia Britannica. Retrieved from November 19, 2018, https://www.britannica.com/technology/melamine-formaldehyde-resin

Woodford, C. (2018, June 27). How do turbochargers work?| Who invented turbochargers? Explain that Stuff. Retrieved from November 19, 2018. https://www.explainthatstuff.com/how-turbochargers-work.html

Woodford, C. (2018, April 10). How do car engines work? Explain that Stuff. Retrieved November 19, 2018, c=-https://www.explainthatstuff.com/carengines.html