Process Engineer for a Day

Introduction

In its simplest form, Process Engineering is the design, development, and management of a wide range of industrial and natural processes. It involves the transformation (chemical, biological or physical) of raw materials into desired products for society in the most economical and sustainable way.

Process, chemical, and biochemical engineers are involved in the design, modification, and operation of processes to produce the things we rely on every day: electricity, petrol, chocolate, cosmetics, cars, aspirin, the list is endless...

This session will introduce you to just one, to design a fragrance from raw materials

Background

Process engineer uses science and mathematics to transform materials in nature into an amazing variety of products that we use every day. The process engineer develops a PROCESS which describes how you take raw materials (plant and flower ingredients) and combine/process them to form a PRODUCT. A process is an orderly description of each task that must be accomplished to make the product. You can think of following a recipe to make a cake as an example of a process. If you do not follow the directions properly, you will not get the best looking or best tasting cake.

The proper recipe/procedure required to make a product is essential. It is here that scientists and process engineers work together. Scientists provide the recipe needed to make a product. The process engineer takes the recipe and forms it into a series of steps (the process) defined by the equipment needed to perform each step. The science defines the order of each step in the process and the process engineer uses mathematics to determine how much product can be made, the quantity of initial ingredients needed and how fast the product can be made. This is of course very important, since a company wants to make a product that is affordable for people, as well as profitable.

The Task

The task covers the process of making your very own perfume. Perfume is a liquid mixture of top notes (first impact, fresh), middle notes (main perfume character) and base notes (long-lasting) in solvents (ethanol, water, matrix). It should be noted that perfumed products appear in our everyday lives as fine fragrances, air care (candles), fabric care (detergents), personal care (shampoos), personal wash (bar soaps), home care (dish wash), etc. The global *flavors and fragrances* market is projected to grow from $26.54 billion in 2022 to $36.49 billion by 2029.

Perfume engineering caters to consumer needs for a specific application or market by providing a new valuable product, following the path: needs, ideas, selection, and manufacturing. Perfumes are formulated products resulted from the shift in the evolution of the chemical industry from bulk products to specific added-value products (electronics, flavors, coatings, fragrances, etc.). Perfume engineering involves disciplines of thermodynamics, transport phenomena, and psychophysics to predict the odor of mixtures of fragrances, evaporation/release of fragrances, diffusion, and performance of perfumes, as well as to predict odor detection thresholds and classify perfumes into olfactory families (perfumery radar) as seen in the fragrance wheel including olfactory Families.

Ingredients:

Before starting your task, please familiarize yourself with different popular notes that can be seen in the Appendix.

- Base unscented oil (e.g., almond oil)
- High-proof alcohol (e.g., ethanol)
- Distilled water, Glycerin, and a Funnel
- Essential oils (at least 1 of each: base, middle, and top notes).
- Clean dark glass containers, **why**? Avoid using jars that have previously contained food items, even if they've been washed out, **why**?

Note: If you are attempting the task with no preparation, then you may use readily available items as substitutes for your trial run, such as vegetable oil any an item for each note, refer to the appendix for more details.

Procedure:

1. Obtain unscented oil such as almond oil.
2. Collect flowers, leaves, or herbs whose scent appeals to you. Be sure to collect plant materials when the scent is strong, and the leaves are dry.
3. You may want to collect and dry more plants than you need just in case you want to add more to strengthen the oil's scent later.
4. If you are using flowers, use only the petals. If you are using leaves or herbs, remove any twigs or other bits that might interfere with the scent.
5. Bruise the plant materials lightly. This step is optional but may help to bring out the scent more. You will just want to lightly press on the plant materials with a wooden spoon.
6. Pour some oil into the glass container. It need only be a small amount; just enough to properly coat and cover your petals/leaves/herbs.
7. Add the plant materials to the oil and shut the lid. Ensure that the lid is closed tightly.
8. Let the jar sit in a cool, dark place for one to two weeks.

9. Open, strain and repeat. If the oil does not smell as strong as you would like it to after one to two weeks, you can strain out the old plant materials and add new ones to the scented oil, then store it once more.

10. You can repeat this process for several weeks or even months until the oil has reached the desired strength.

11. Be sure to keep the oil! It's the old plant materials that you want to discard.

12. Preserve your scented oil. Once you are happy with the oil, you can add 1 or 2 drops of glycerin to your scented oil to help extend its life.

Now you have completed the task, spend some time to think about the process and suggest ways (design changes) to make the perfume manufacturing process continuous.

Alternative method:

1. Pour 2 tablespoons of base oil into the dark glass bottle.

2. Add your essential oils. You'll want to add roughly 30 drops in total. Start with your base notes, then add your middle notes, then add your top notes. The ideal ratio is 20% base, 50% middle, and 30% top. Take one scent, add a few drops, swirl, smell, add more or continue. Take the next scent and repeat as above until you have added the approximate number of drops. Feel free to vary the concentrations to create the desired fragrance.
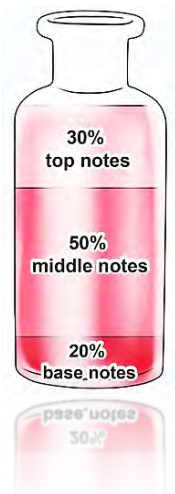
   Hint: Pay attention to the scents that you are adding: if one scent is much stronger than the rest, you will want to add less of it so that it doesn't overpower everything else.

3. Add 6 tablespoons of alcohol. Use a high-quality alcohol with a high alcohol content.

4. Allow the perfume to sit for at least 48 hours. Shut the lid and allow the perfume to cure for at least 48 hours. You can leave it for up to 6 weeks, which is when its scent will be at its strongest.

5. Check the bottle regularly to see where the scent is at.

6. Once you are happy with the scent, add 2 tablespoons of distilled/bottled (not tap, why?) water to your perfume. If you are making a perfume spray, add more water.

7. Shake the bottle vigorously. Do this for 1 minute to ensure that the contents are well blended.

8. Add approximately 5 drops of glycerin, this helps preserve the fragrance.

9. Transfer the perfume to your labelled bottle. Using a funnel, pour your perfume into a clean, dark glass bottle.

10. You may want to label the bottle with the ingredients and a date on it so that you can keep track of how long it lasts. That way, you will know whether you should make more or less the next time.

Consider this…

What do we learn from these recipes? They are two different procedures but related products. How can an engineer describe this process (steps, equipment…)? And how can a Process Engineer design, manipulate and control the manufacturing process (i.e., enhance the perfume quality)?

Record your participation

• After completing the task and posting your work to the Padlet, ensure that you complete this form to record your participation to acquire your Certificate of Participation.

Appendix: Common Ingredients of Perfume Notes
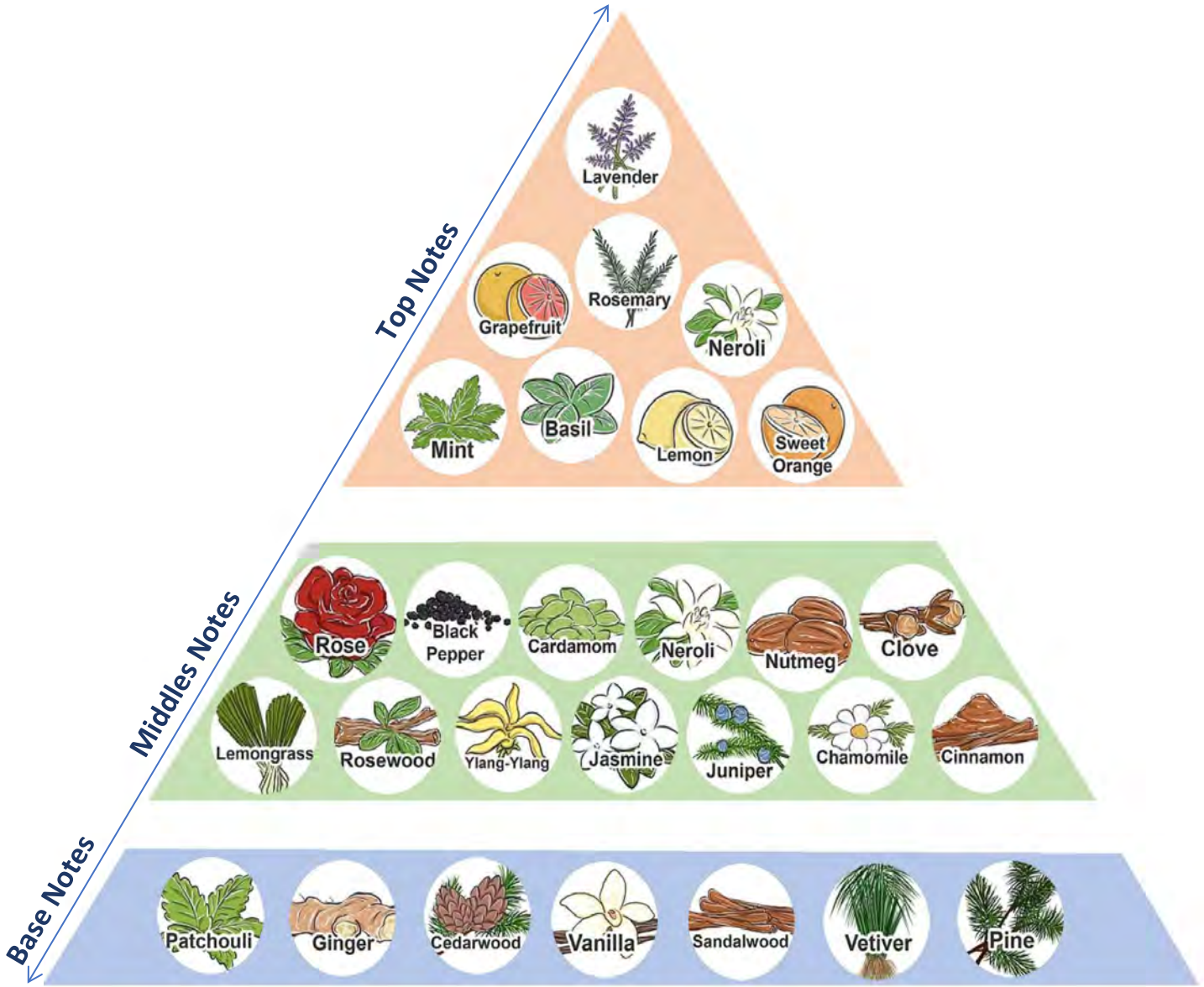
Want to know more about the notes of your favourite perfume? check the BaseNotes website for the details.