AEROSOL 101
Formulation Considerations

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OVERVIEW

- Aerosol Product Formulations
- Type of Carriers
- Performance Parameters
- Government Regulatory Considerations
- Toxicity Concerns
- Aerosol Hardware
- QC Procedures & Process Parameters
- Finished Product Tests
Aerosol Product Formulations

- **Scope** – this presentation will focus on the basic format of a chemical formulation, involving a component-to-component compatibility test. It’s a useful elimination process that help shorten the formulation development.

- **Chemical Formulation** – is the process by which different substances, raw materials are combined to produce a finished product.
Aerosol Product Formulations

- **Stages and Timeline** – formulation studies involve developing a preparation of the components or ingredients which should be both stable and acceptable to the end-user. Also, it should consider such factor as particle size, pH, and solubility, as all of these can influence the raw materials availability and activity of the active component. Pre-formulation should involve the characterization of the active component’s physical and chemical properties in order to choose what other components should be used in the preparation.
Aerosol Product Formulations

- **Raw Materials Availability** – with the advancement of the computer technology, it’s now easy and convenient to search for chemical additives through a website that offer a complete technical and supplier’s information.

- **Functionality** – usually discussed by the Management Team involving Marketing, Technical, Production, Purchasing staff…presided by a top-executive officer like the company’s President. Issues commonly discussed are what product features and benefits that their company is selling to their customers? What is their company’s profit margin goal?
Aerosol Product Formulations

- **Reverse Engineering** – should be done prior to initiating the first experimental trial formulation in order to gather information like % non-volatile, carriers, propellants, etc. A material safety data sheet (MSDS) is also a useful source of information in getting a rough idea about the chemical composition and the CAS (Chemical Abstract Service).
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<th>Lubricants</th>
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# Type of Carriers (Solvent-Based)

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Performance Parameters

- Product stability and shelf-life
- Finished product should not exhibit degradation or separation over time.
- Physical and chemical properties – zero or low VOC, flash point, % NVM, flammability, specific gravity, viscosity, particle size, pH, non-toxic, etc.
Performance Parameters

- **Spray characteristics:**
  - small particles (<10 microns) for inhalation therapy; the aerosol must produce a spray so that the product can reach the lungs.
  - fine spray for space application e.g. room deodorants and space insecticides.
  - very wet or very fine spray, a medium particle size are most suitable for personal deodorants, hair spray, colognes, and coating compositions.
Toxicity Concerns

Blending and packaging – is covered by OSHA (Occupational Safety Health Administration) and will require the company to train their production workers to undergo safety training by a certified safety coordinator. A complete MSDS (Material Safety Data Sheet) contains the following:
Toxicity Concerns

- Toxicological Information
- Components Amount and its Exposure Limits
- Physical and Chemical Properties
- Ecological Information
- First Aid Measures, etc.
- End-Users – are usually provided by the manufacturers an MSDS for every chemical product they ordered and is attached in the item.
Regulatory Considerations

- **VOC** – Volatile Organic Compound, present limit for aerosol is 25 grams/liter. Various States have adopted restrictions on VOCs in certain categories. There are Federal regulations as well, but the State regulations are more stringent and are the ones to worry.
Regulatory Considerations


- **RoHS** – Restriction of Hazardous Substance. For European Union’s electrical and electronic equipment.
Aerosol Hardware

- Aerosol Valves
  - Male Valves, Vertical, Tilt, and Metered
  - Female Valves

- Actuators
  - Dispenses product, provides a controlled spray, and controls particle size.
Aerosol Hardware

- Stem Gasket
  - Buna, Neoprene, Butyl, and Viton
  - Provide a gas tight seal, remain effective over time when exposed to product concentrate and propellant, and to temperature changes.

- Aerosol Cans
  - Made of Steel, Aluminum, Glass, and Plastic
QC Procedures & Parameters

- **D.O.T. Regulations**
- **Container Pressure Specification**
  - No Specified Container  < 140 psig @ 130 F
  - 2P Container  > 140 psig but < 160 psig @ 130 F
  - 2Q Container  > 160 psig but < 180 psig @ 130 F
  - Steel Cylinder  > 180 psig @ 130 F
  - 27.7 fluid oz. (50 cubic inch) Maximum Fill
QC Procedures & Parameters

- **QC** Technicians are required to check the internal pressure of the aerosol can using a pressure gage periodically at random. Also, to check and record the product fill, solvent fill if applicable, and the propellant fill.

- **Documents** – QC is equipped with control charts that contain specifications for valves, actuators, cans, caps, and with or without extension tubes and stainless steel balls. Keep retain aerosol samples for every batch run by the production people.
Finished Product Tests

- **Finished Chemical Formulation** – should undergo series of tests to verify that its product features such as rust & corrosion inhibition, lubricity, stability over time, etc. are met satisfactorily.

- **Aerosol Product** – should be retested by spraying in a metal substrate made of steel, aluminum, etc. to insure that its spray pattern, flow rate, dry-film appearance is smooth & uniform etc. and they are within the spec as required by the end-user.
Finished Product Tests

- **Certification** – These series of tests must be done internally first, when the team of managers approved the results, then send a prototype sample to an independent laboratory for formal certification. This is a very expensive procedure to gamble. Big companies normally require certification that meet certain military, industry, and other specifications. Sub-companies in an industry would use those spec as a criteria to purchase a product.

THANK YOU for your time and patience! Questions!