



## DESIGN AND FABRICATION OF PAPR SYSTEM FOR POWDER COATING

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**Abstract:** The project defines the problem faced by the workers in powder coating industries. Powder coating is a process by which electrostatically charged powder is applied on to an earthed object. The health effects that a worker may experience following exposure to a hazardous chemical can become apparent after a short period of time, and includes headaches, nausea or vomiting, dizziness, burns to skin and eyes an irritation to the nose, throat and lungs. Long term health effects include asthma, dermatitis, kidney or liver damage, cancer and central nervous system. The solution for the factors affecting the worker's health and life, should provide the proper protective equipment. Our design approach provides proper ventilated respiratory system to the person wearing personal protective equipment, with air purification by providing the filters which will purify the air pumped inside the kit.

**Keywords** - Air purification, Health, Personal protective equipment, Respiratory system, Safety, Workers.

### I. INTRODUCTION

Powder coating is a technique in which dry powder is used for coating the surface in the finishing process. There is a lot of variety in the powder coating where the dry powder is used as free-flowing agent. In this methodology the powder is used as applying agent used to protect the surface this powder coating also helps to make the product decorative. Powder coating process can be used for huge range of the materials which can be used for commercial as well as domestic products Powder coating is finely ground plastic particles of resin, pigment & extenders, and various flow additives and fillers in the thermoset or thermoplastic powder is added according to the specification, which is sprayed on the surface for coating. The chemical composition sprayed during powder coating operation can be fatal sometimes due to which it can cause severe respiratory problems and also skin infection. According to National Institute for Occupational Safety and Health (NIOSH) dust mask or particle mask with a standard of N95 or higher is approved and acceptable by NIOSH. These N95 mask restricts the amount of powder and therefore prevents for any respirational, skin 2 problems. N95 mask which works as a negative reusable pressure cartridge causes breathing issues. So, to deal with such issue PAPR system in been introduced which creates positive pressure cartridges during inhalation. This system lessens the number of chemical fumes entering which prevents from further respiratory problems. It also creates a friendly working environment which directly increases the production and is more comfortable for workers then N95 negative pressure cartridges system. Here, P100 filter is more efficient than N95 mask as it can restrict and filter up to 99.6%. These P100 filter can be reused by wiping out by isopropyl or Lysol or any disinfectant spray.

#### 1.1 Types of Powder Coatings

The powder used in powder coating is made up of mixture of resin and pigments in powder form.

Types of powder used as under:

- a) Polyurethane
- b) Polyester

- c) Straight epoxy
- d) Fusion-bonded epoxy

## 1.2 Problem Statement

During powder coating operation most of the workers face certain issue like inhaling the chemical which causes nose irritation and in severe cases can cause lung infection. Also, exposure to this chemical fume for longer duration can cause skin, eye burn and dermatitis.

## II. METHODOLOGY

To eliminate such problem, we have developed a PAPR system with a positive air pressure which is automatized with a help of multi-purpose pump consisting of filtrating unit to restricts the amount of exposure of hazardous chemical to the workers, working during the operation of powder coating.

### 2.1 Research Objective

The purpose of research started with the problem faced by the workers working in powder coating industries. Powder coating is a process by which electrostatically charged powder is coated on the earthed objects. The exposure to this electrostatically charged hazardous chemical causes adverse effects such as headache, nausea, vomiting, dizziness, burns to skin and eyes and irritation to respiratory system. Long term health issues include Asthma, dermatitis, kidney or liver damage, cancer and central nervous system.

### 2.2 Background Research

According to National Institute for Occupational Safety and Health (NIOSH) dust mask or particle mask with a standard of N95 or higher is approved and acceptable.

### 2.3 Market Research

According to our conducted survey we collected information regarding uses of protective mask while working with powder coating operation. Coming to verdict of conducted survey, we found out that most of industries followed the guidelines issued by NIOSH, while some of industry wore normal mask (lesser than the class of N95). Here the N95 or any other protective face mask works as negative pressure cartridge which often cause inhalation problem (breathing problem) which makes them uncomfortable while powder coating operation. These causes them hard to breath which makes an unhealthy working environment which will directly affect the production.

### 2.4 Proposed Solution

As above mentioned, problem faced by N95 mask by workers, we came up by this idea of providing PAPR (Powered air purifying respiratory) system which is a positive pressure air respiratory system solving breathing issues and making comfortable working environment.

### 2.5 Design Concept

Our design concept includes protective face shield with integrated PAPR system which includes:

#### 1. P100 Filter

The P100 filter is rated highest for personal respiratory protection. A P100 filter will block 99.9% of particles 3 micron or larger.

#### 2. Multi-Purpose Air Pump

The inlet valve of electric air pump is installed with the vapor filter which acts like suction and then processes the filtered air through outlet valve.

Ratings of Multi-Purpose air pump, 110V-120V, 0.65A, 50Hz

### III. FIGURES AND TABLES

Table 1.1 Health Issues Caused by Types of Powder

Sr. No	Type of Powder	Health issue
1	Polyurethane	1) Asthma 2) Vomiting 3) Headache 4) Nausea 5) Throat infection 6) Eye irritation
2	Polyester	1) Respiratory infection 2) Skin problem
3	Straight epoxy	1) Skin inflammation and skin burns when in direct contact. 2) Dermatitis.
4	Fusion-bonded epoxy	1) Eye irritation 2) Carcinogenic

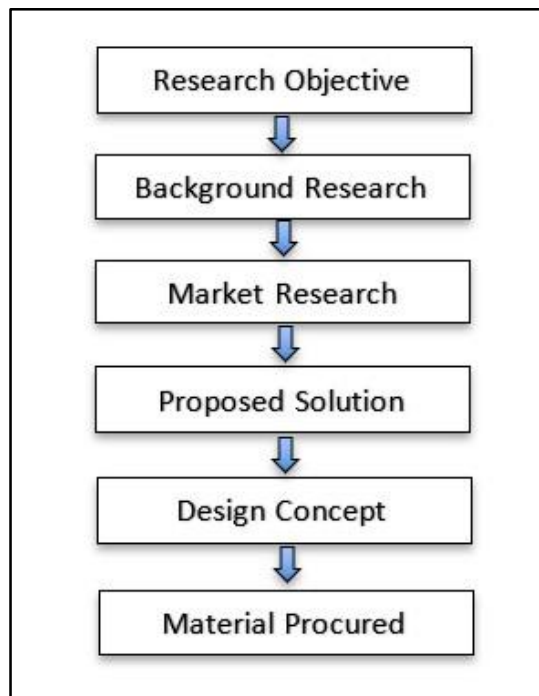


Fig. 2.1 Flow Chart of Methodology

Table 2.5 Material Procured

Sr. No.	Component Name	Description	Quantity
1.	Multi-Purpose electric pump	12V	1 Nos
2.	Filter	P100 Respirator Filter	1 Nos
3.	Battery	18V Lithium ion	1 Nos
4.	Hose	Flexible Hose	1 Nos

#### IV. CONCLUSION

According to our survey we found out that the workers working in powder coating booth used mainly N95 mask or similar type, as N95 is a negative pressure equipment didn't fulfill the need of workers so we came up with the solution of positive pressure respiration system i.e., is PAPR (Powered Air Purification Respiratory System) this system not only mitigates the problems but also makes comfortable working environment which directly affects the production growth of company. Hence, we conclude our design in PAPR system for powder coating.

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