

## Product Safety in Colourants

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Product safety although relatively a recent issue, is rapidly assuming increasing importance in the speciality chemicals business. Product safety relates to the study of chemical, physical, toxicological and ecotoxicological properties of chemicals. In that sense, it is to be differentiated from personal, process or operational safety. The data pertaining to product safety is important as this is very much required for the material safety data sheet (MSDS). Product safety study also helps for certification of conformance of the products to various regulatory standards such as EN 71/3. The various facets of product safety includes the different test results involved, the significance of these tests, use of test results to design equipment and operations for manufacturing, arriving at safe storage and transport conditions. Considering the ever increasing demand for eco friendly and safe products and processes from consumer industry, society at large and the authorities, it is certain that focus on product safety will be ever increasing for a long time to come.

Various kinds of risks with peoples handling the products at various stages is depicted in Table 1:

**Table 1: Kind of risks and controls**

	Type of risk	Control
Pigment Manufacturer	Fire, Explosion, Toxicity	Statutory regulations, In house safety guidelines / practices
Primary/ Secondary Customer	Fire, Explosion, Toxicity	Statutory regulations, In house safety guidelines / controls
Consumer (public)	Toxicity	Application wise statutory regulations, directives
Environment	Pollution	Statutory regulations

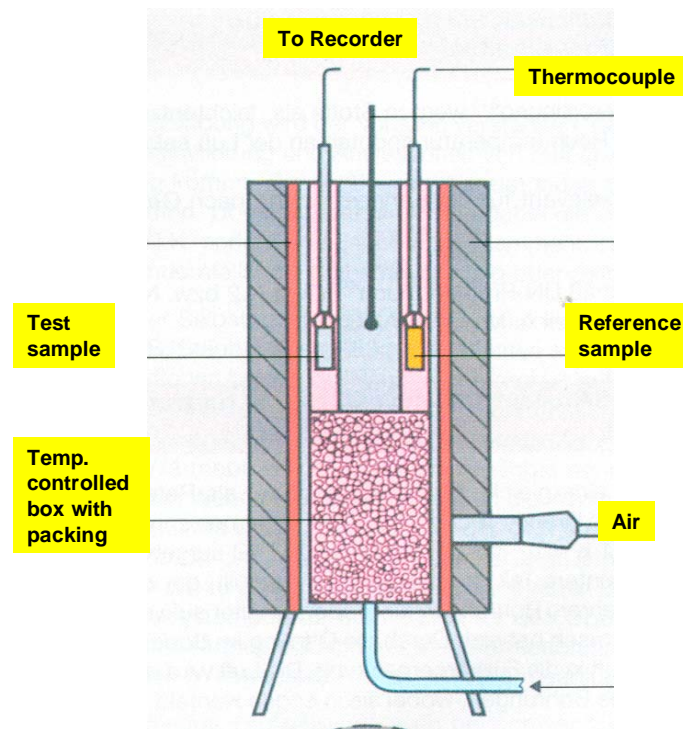
The activities of product safety includes understanding properties of substances, identifying risk factors or the properties which could lead to dangerous situations, devising ways to avoid dangerous situations, compilation of the data and communicating the data to the concerned.

The first step in product safety is, understanding the product by studying the properties of the chemical substances from all the angles such as physical and chemical properties, toxicological properties and ecotoxicological properties. The physical and chemical tests are done mainly to study the burning behaviour of the substance. The tests done are with product layers for Combustibility Index (CI), Auto Ignition (SIT), Exothermic Decomposition (DTA), with dispersed products for Dust Explosibility. These tests are performed as per the VDI (*Verein Deutscher Ingenieure*) Guideline 2263, which is widely accepted.

### **The physical and chemical tests**

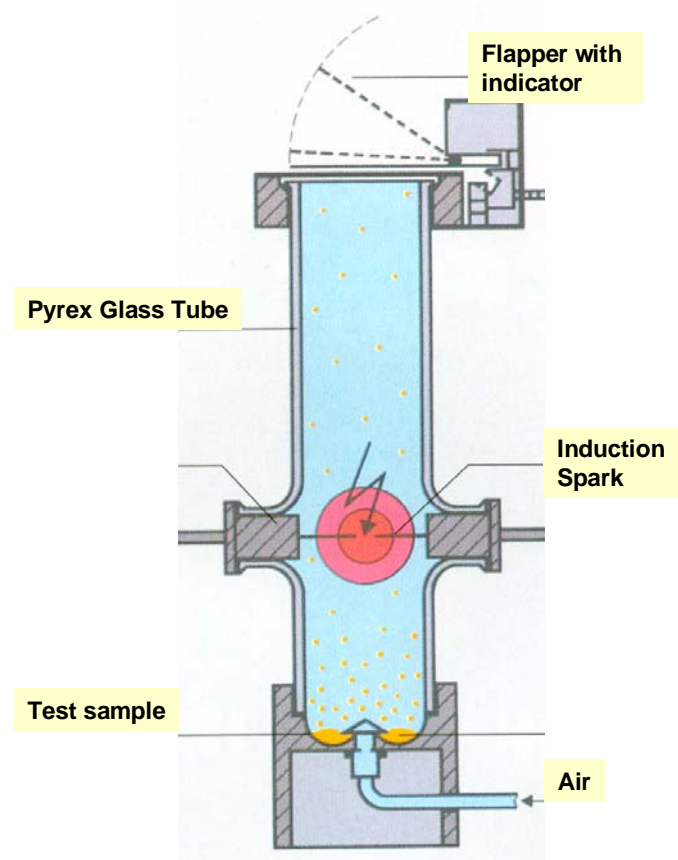
The combustibility index is significant for fire fighting measures and its purpose is to determine whether an external source of ignition can propagate a fire in dust layer to any extension. The method involves igniting a 5 cm strip of sample which is placed on ceramic plate. The combustibility behavior is observed and rated on 1- 6 scale (1- No ignition, 6-rapid flame propagation).

Auto ignition test is significant for the drying, storage and transport conditions with respect to temperature and quantity. Exothermic decomposition is done to determine the temperature at which a substance undergoes exothermic decomposition in presence of heat - but in the absence of air (Oxygen). Test sample and reference sample are sealed in crucibles and heated in an oven. The point at which the sample temperature exceeds that of reference is Exothermic Decomposition Temperature. The test is significant in process and operations conditions.



### Grewer Oven

The design of the milling equipment and conditions are determined by the Dust explosibility test. The purpose of this test is to determine whether the dust of a sample is explosive. Dust is considered explosive if there is flame propagation after igniting the dust-air mixture, resulting in a pressure rise in a closed vessel. The method involves the following stages. Test sample is deposited at the bottom of the tube and dispersed with a blast of air. The dust-air mixture is ignited and observation is made (Hartmann Apparatus).



### Hartmann Apparatus

The milling conditions are also designed by determining minimum ignition energy. It is the lowest value of energy which is just sufficient to ignite a dust/air mixture of a substance at room temperature and atmospheric pressure. The test method is essentially the same as in the case of dust explosibility (Hartmann apparatus), but it is connected with capacitors which can give discrete amounts of energy. After several trials with various concentrations of dust, the minimum energy which will just cause ignition and which will not cause ignition are determined.

### Toxicological / Ecotoxicological Tests

The purpose of Toxicological / Ecotoxicological Tests is mainly to study the effect of substances on humans & ecology. The various tests are Acute Oral Toxicity, Irritation to Skin, Irritation to Eyes, Ames Test and Acute Aquatic Toxicity. These tests are performed as per **the OECD** (*Organization for Economic Cooperation and Development*) **Guidelines** which are widely accepted.

The acute oral toxicity test is done to determine whether a substance can cause toxicity if it is ingested. For this test the substance is suspended in groundnut oil and administered once orally to wistar rats and observed for 15 days. Any mortalities or toxicity signs are observed and recorded. Substances with LD50 values of more than 2000 mg/kg are considered safe.

The skin irritation test is carried out to determine whether a substance can cause irritation if it comes in contact with skin. The substance is moistened with groundnut oil and applied to the prepared area of the skin of a rabbit. Application is removed after 4 hr contact and the skin is observed for any signs of irritation.

The eye irritation test is important as it finds out whether a substance can cause irritation to eyes. For this, the substance is instilled into the conjunctival sac of an eye of a rabbit. Eye is washed after 24 hr contact and observed for any signs of irritation (redness, swelling, discharge and any effects on iris and cornea).

Ames test is considered to be an important test method among toxicological and ecotoxicological tests. This is performed to determine whether a substance is mutagenic. Mutagens are those substances which are capable of altering genetic material (genes, chromosomes) in a living cell. It is thought that many types of cancers have their origin in mutations taking place in a cell. The tests are done with five strains of bacteria - *Salmonella typhium* at different concentrations of the substance and any alterations in the genetic material of the bacteria are observed.

Acute aquatic toxicity test will determine whether a substance can harm aquatic life if it contaminates water. Fish are exposed to water containing the substance at a concentration of 100 mg/lit for a period of 96 hr. Any mortalities or toxicity signs are observed and recorded. Substances with LC50 values of more than 100 mg/lit are considered safe.

### **Product safety in pigments**

Organic pigments are extremely insoluble in water and organic solvents. Hence pigments are generally not bioavailable, thus have, in general, favourable ecological and toxicological profile.

Monoazo Pigments generally possess low acute toxicity (LD50 > 5000 mg/kg), and chronic toxicity. P.R.57.1, P.Y.100 and P.Y.104 are approved as FDC colourants in

this class of pigments. Barring P.O.5 and a few nitro group pigments (deflagration), most monoazo pigments do not have any serious hazard.

Disazo Pigments have normally low acute toxicity ( $LD_{50} > 5000$  mg/kg). A few amine treated diarylide pigments cause irritation to eyes and skin. Diarylide pigments have been thoroughly tested for chronic toxicity and mutagenicity, as they are derived from DCB. There is no evidence so far of metabolic breakdown to DCB and hence of carcinogenicity. Thermal breakdown occurs when processed at temperatures above  $200^{\circ}\text{C}$  limiting the possibility on use in plastics.

### **Material Safety Data Sheets**

The purpose of Material Data Sheets (MSDS) is to make the user of the product aware of the physical, chemical, toxicological and ecotoxicological properties of the product. The data determined out of "Product Safety Tests" contribute to the creation of MSDS. MSDS serves a guideline for the user while handling the product. This could be made in different styles / formats. However, the one recommended by the commission of the European community, is elaborate and is widely used. This format has 16 chapters covering various product safety and regulatory aspects.

The various chapters include identification of the substance / preparation and of the company / undertaking, so that in case of emergency the producer could be contacted, composition /information on ingredients, hazards identification, first-aid measures, fire-fighting measures, accidental release measures, handling and storage, exposure controls/personal protection, physical and chemical properties, stability and reactivity, toxicological information, ecological information, disposal considerations, transport information, regulatory information, and other information.