CHAPTER -1
INTRODUCTION

1.1 IMPETUS FOR RESEARCH

Since early civilizations, the particular hazard posed by *Burning of Textiles* was well recognized. Still, the risk persists and it is becoming a major problem for the human beings in the present world especially in case of apparels. In most of the textiles related fires, though cloth is rarely the direct cause of fire, the burn severity caused by the textile clothing, identified as the prime cause of death. The death primarily occurs due to loose fitting garments wore directly over the body during the event. The smoke and emitted gases cause disorientation and impede escape initially followed by subsequent incapacitation, asphyxiation and death.[1]

Clothing fire being the individual in nature receives little public attention, unless and until the affected groups due to hazards are identified, such as been in the case of children wear, nightwear in Australia, UK, USA etc.[2] These developed countries have comprehensive fire statistics, which helped them to analyse and target the specific group of people and garments, which suffered during fire accidents. Their governments enforced many Regulatory Acts[3,4] as a result of which manufacturers have to use specific parameters to design the garment. The garments are also well-listed and labeled for awareness and safety of the people.

India being one of the populous countries, people stays in different types of dwellings and use different types of clothing as per their traditions, living standards and type of communities. The use of specific type of garment also depends on the geographic region and weather conditions. Therefore, the protection from fire accidents and prevention of fire fatalities become essential day by day. In case of India, a limited textile related fire statistics data is available. Moreover, government regulations are not inflicted on the garment manufactures to meet any norms of flammability test for textiles. Even the consumers are not aware about the flammability of cloth they use.

1.2 RESEARCH OUTLINE

In the present study, an extensive survey on the burn injury is carried out with references to 360 cases of fire accident victims. The study reveals the potential cause of fire, place of fire and fuel involved in the fire accidents, gender wise age group, type of garments, its pattern and raw material. The levels of burn injuries on different body parts of the fire victims were also considered. This survey reveled that the majority of fire accidents occurs at kitchen and more number of the victims were the female mainly wearing saree. Hence, the study of burning behaviour of saree materials became the thrust of this research.

Thus, this research is an attempt to study the various factors influencing the thermal properties of textiles in general and flammability of saree in particular and rank them according to their hazard potential to life of the user.

As there is no specific equipment and method available to analyse the complex burning behaviour of saree, it was necessary to develop a proper method and effective equipment for the aforesaid reason. Most of the flammability tests are based on pass-fail criteria and do not provide direct idea about the hazard potential of the any textile clothing.

The study of burning behaviour of fabric sample itself is a complex phenomenon and when the fabric is converted into garment and when it needs to be tested along with the supporting garments, it becomes more difficult to carry out the study in actual field conditions. In order to analyse burning behaviour of saree along with supporting garments like petticoat, blouse, (brassiere) bra and underwear usually wore along with saree, a realistic approach required to be maintained as per the actual wearing pattern of saree. The normal saree-wearing pattern covers around 70% of the Total Body Surface Area (TBSA). About 7 to 8 metre fabric is supposed to be wore along with the supporting garments which makes the saree more hazardous than any other garment in the event of fire. The saree is wrapped on body surface with multiple layers on different postures of the body. Due to the complexity of wearing of multiple layers, analysis of burning behaviour of

saree becomes a stringent task. Therefore, it needs to develop suitable techniques of specimen selection considering the combinations of saree and supporting garment fabrics at different zones of body.

All textile materials normally used for saree and its supporting garments such as woven and knitted fabrics made, using cotton, polyester, nylon, silk, viscose and their blends, need to be selected as sample specimen for testing and ranking purpose.

Similarly, apart form the conventional approach of testing ignitability and other thermal parameters of fabric samples, a logical and realistic approach of measuring the heat flux at the base of the fabric sample, which is responsible for the thermal degradation of human skin, need to be measured. This measured heat flux is to be used for analysing the degree of burn injuries. The equipment should be developed in such an manner, that it can measure important thermal parameters such as time for ignition, rate of flame propagation, rate of burning, heat absorbed and incident heat flux and should plot the time-heat flux profiles of test specimen.

It was thought that the study should not be limited to the type of fibre of saree and supporting garments and their combinations, but the effect of fabric physical and chemical properties on its burning behaviour needs to be studied. Various fabric structures, mass density and type of dye used for the fabrics may be selected.

The effect of aftercare practices like washing, ironing and exposure time to light and blueing also should be considered.

A three Dimensional mathematical model is required to be developed to study the heat transfer process in human skin. The technique should be intended for the prediction of temperature and burn injury at various layers of human skin at various heat fluxes on the surface of the skin by using finite differential discreatization scheme. The temperature measured at the basal layers of

epidermis, dermis and hypodermis should be used to predict the degree of burns to the skin.

Finally, it was planned to compare the ranking and results obtained from all the study with the actual fire victims cases for validation.

Hence, objectives of this research are an attempt to:

- Locate the group of people and garments, which are at high fire risk and pose the hazard potential.
- Develop a method and economically viable equipment for analysis of burning behaviour of textiles based on a realistic approach.
- Measure the flammability of several saree materials along with their supporting garments and correlates the thermal properties to burn injuries for ranking each saree according to hazard potential.
- Propose a mathematical model for heat transfer in human skin, for the prediction of temperature and burn injury at various layers of skin at various levels of heat fluxes on the surface of the skin.
- Predict co-relations between all the thermal parameters tested thereof.
- Study the effect of fabric weaves, fabric mass and type of dye on the thermal properties of textiles.
- Study the effect of after care practices on the thermal properties of textiles, and
- Compare the obtained ranking for saree and burn injury status with the actual victims for validation.