3 A rising community of workers wearing protective clothing

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Abstract
When one meets a stranger, the identity analysis of the stranger commences. First by the visual appearance/communication through the clothes they wear, and subsequently by asking what do they do? Thus, making fashion and their work as major contributors towards perceiving their identities. Clothing is a mediator between the naked body and a self-symbol to the world.

If one meets a group of people, who have qualified for doing a particular job, wearing particular clothing that ensures their safety and tackles danger for the wearer, it creates a sense of belonging and identity. Thus defining them as a community - a group of people having these characteristics in common. The challenge that this identity brings can have a positive as well as a negative impact. The idealist will look at this identity as a boon, with a sense of pride to celebrate what they do and where they belong. It creates a sense of self-assurance towards safety. On the other hand, such identity creation could also lead to a sense of loss at the position in the work place.

The authors conducted an in-depth qualitative analysis of workers from the petrochemical industries (n=200) of Northern and Western India to understand their acceptance, behaviour and reaction to protective clothing (PC), using a questionnaire based on the Likert scale; and open-ended questions to understand their acceptance, behaviour and reaction to protective clothing (PC). They discuss how not just the wearer but also the audience perceives them in their workwear. The statistical findings from the study indicate that the workers were well aware of the importance of PC in petrochemical industries. It was observed that previously different tasks were assigned different uniforms, but at present irrespective of the hierarchy, each worker is wearing the same PC. The research shows how this creates a rising collective identity from an individual identity, founded on role-based identity.

Introduction

Clothing contributes to how people define and perceive themselves and is a necessary part of everyday life. Clothing promotes a feeling of wellbeing and has the potential for a multidisciplinary functional approach. To be acceptable and comfortable, products must look stylish and attractive and function reliably in relation to technical and aesthetic concerns of the wearer. Good aesthetic and technical design, driven by meaningful end-user research, can help exploit niche markets where form and function work in harmony in the research and development of comfortable and attractive products that can assist us in many aspects of our daily lives (McCann, 2005). When one sees a person wearing camouflage print uniform, a direct relation with armed forces is made. Similarly, seeing a person dressed in a white coat and carrying a stethoscope is a uniform universally accepted for doctors. These visual appearances based on uniforms create a sense of fashion semiotics and help build a community.

The origin of clothing started with the need for protection and modesty. The need for clothing to function for protection has given rise to the protective clothing segment. Protective clothing (PC) is part of Personal Protective Equipment (PPE), which is designed with the sole intention of protecting the wearer from injury or infection. PC includes all clothing and equipment worn over or in place of normal work clothing for the purpose of protecting the workers from harmful chemicals, heat exposure, toxic gases etc.

This paper looks at PC for petrochemical industries. A petroleum refinery's main job is to split crude oil into its many parts (or fractions), which are then reprocessed into useful products. The type, number, and size of process units required at a particular refinery depends on a variety of factors including the type of crude oil and the products required. The interconnected units making up a refinery are a maze of tanks, furnaces, distillation towers (fractionating columns), reactors, heat exchangers, pumps, pipes, fittings, and valves.

Products of crude oil refineries include fuels such as gasoline, diesel fuel, heating oil, kerosene, jet fuel, bunker fuel oil, and liquefied petroleum gas; petroleum solvents including benzene, toluene, xylene, hexane, and heptane, which are used in paint thinners, dry-cleaning solvents, degreasers, and pesticide solvents; lubricating oils produced for a variety of purposes, and insulating, hydraulic, and medicinal oils; petroleum wax; greases, which are primarily a mixture of various fillers; asphalt. These products can be hazardous not only in their final state but as they are being processed and refined.

Designing Protective Clothing

Protective clothing may not do much to reduce the harmful effect of chemicals but it does set up a barrier against chemicals thus enhancing the safety of the people working under hazardous conditions. When selecting or designing protective clothing many factors have been found to influence its effectiveness. Each potential hazard

has different problem areas and requires specific solutions in the form of appropriate PC.

Protective clothing should be similar in design or style to the regularly worn work clothing. Thus problems associated with chemical penetration, garment comfort, aesthetic styling and sizing should be solved at this stage. The key requirements of design development for PC involve functionality and comfort. The study is based on interviewing workers in petrochemical based industries, and for PC to be acceptable it needs to have a multidisciplinary approach to strike a balance between providing safety and protection, functionality, human comfort and psychosocial aspect. Along with these factors PC should be economical so that small-scale and medium-scale industries can afford them.

The design concept for functional protective clothing, where the design criteria for functional protective clothing must be unequivocally specified, for example protection from chemicals, is achieved by blocking their penetration and permeation through the fabric of the clothing. This is an effective method for providing sufficient protection; however, total blockage of the penetration and permeation also affects the transport of any heat and moisture generated by the wearer of the protective clothing, and results in possible heat stress. It witnesses the complexity of designing protective clothing and asks for even higher requirements when designing this type of protective clothing, both from the point of view of protection and comfort, and from that of functionality. Thus, the current status of PC clearly shows a need for developing PC that is functional, comfortable and also has aesthetics. The same was reflected in the interviews with the workers, which will be discussed later in the paper.

Taking the cue from Lurie's 'The Language of Clothes', clothing is a part of communication, where clothing stands as a metaphor to disguise one's identity (Lurie, 1981). Blending the designing of PC with identity generation leads to a sense of team building with uniformity. Similar to Lurie, Rouse in 'Understanding Fashion', further adds communication as important function of clothing. This was based on Malinowsski's (a functionalist anthropologist) research stating that shelter and protection are part of cultural responses to basic physical needs (Rouse, 1989).

Based on the statistics gathered, it has been proven that the there is no guarantee that personal safety equipment would be able to prevent the accidents that would result in injuries from happening, but would be able reduce the possibilities for it to happen (R.Hrynyk, 2015). According to Rosli Ahmad, precise safety applications could help in lowering accidents at various petrochemical industries, and also to reduce production prices, grow productiveness and profitability, as well as, more importantly save people's lives.

According to PR Newswire (New York) January, 2014 the Protective Clothing Market is expected to grow at a CAGR of 6.0% over the next five years to reach $8

billion by 2018. Asia-Pacific, with its flourishing economy and rapidly expanding industrial sectors, is an emerging market and will experience the second-highest growth in demand during 2013 to 2018, after North America. This global market is analysed in terms of revenue ($million) application-wise, on the basis of fabric type, end-user industry-wise, and user type-wise for all major regions, namely, North America, Europe, Asia-Pacific, Middle East and Africa, and Latin America. Major countries in respective regions further break down the revenue figures. Aramid & blends, polyolefin & blends, polyamide polyethylene, cotton fibers, laminated polyesters, and others (various rubber types, leather) are the major materials used for the production of protective clothing. The major users of this clothing are consumers for personal use, and industrial users in risky and hazardous working conditions.

There is a distinct lack of safety culture in various medium and small-scale industries in India, in spite of there being so many petrochemical and chemical industries the concept of protective clothing is still in its infancy. The solution to this problem lies in educating the workers about the safe handling of chemicals. In the majority of the units/industries workers are wearing work clothes, but they provide hardly any protection against harmful chemicals, and often the protective suit available is uncomfortable. Workers are provided with accessories such as goggles, gum boots, masks, helmets and gloves; but many workers do not use them because of the discomfort in wearing them in hot and humid climates (Suri, 2002).

Notion of building a global community

A Global Community means people of varied origins from national and international regions who together form a community within and outside of a designated physical space, while catering to diverse norms and values, which communicate their perspectives and visions about their beliefs and world. It is a notion of belongingness created by individuals and groups to integrate cultural norms and values that are acceptable into their everyday lives in meaningful ways. Implementation of the goal of building global communities within an identified context corporate organization, educational institution, as well as corporate and community services, for example, encourages a favorable partnership in which social responsibility and accountability for actions are situated within the framework of the broader participating community that engages in that intercultural communications in any way whatsoever**.** As mentioned by Patel, F. et al. in ‘Intercultural Communication: building a global community’, it is believed that building global communities is an attainable and honorable goal; one that requires a deep respect, love and compassion for humanity, commitment to social responsibility and upholding of social justice, and the belief that together it can overcome adversity. Individuals have different roles or have been assigned different tasks but they all have social responsibility roles. Their social responsibility roles create an imperative for them to make a concerted effort to contribute to global community building.

Uniforms, as the word suggests, are clothes that unify and are constructed to the same repetitive format. Most people have experience of school uniforms, others of specific working clothes such as surgeons who wear special gowns when in the operating theatre, nurses who attend to them, or guards' uniforms on public transport and in museums and art galleries. What one wears influences how fellow human beings see each other. People talk of 'dressing for the occasion' and work clothes often differ from those that one wears for relaxation (sometimes called 'home clothes') or other non-work occasions. Workwear is a visible part of the corporate image. Work uniforms that are presentable and appropriate are an essential factor with regards to occupational safety and comfort at work. There are different kinds of uniforms throughout the world that give people a distinctive ordered identity. Uniforms are generally functional but can also be aesthetically comfortable. These uniforms generate an idea as the wearers participate in specific activities, which help develop a sense of belonging, in turn generating an identity that is beyond the person. This belongingness can take over other pieces of a person's identity and create a larger brand image, hence creating a community of workers wearing PC.

Objectives of the Study:

- To identify the petrochemical Industries in Northern and Western regions of India and understand acceptance, behavior and reaction to protective clothing.
- To explore experiences of the compliance of PC and its effects on building confidence in a worker, and whether they see themselves as part of a global movement
- To conduct a survey to analyse whether protective clothing brings a sense of belonging, and building a community that promotes wellbeing and safety in the industry.
- To signify that this rising community spreads positive notes of wellbeing to future generations, promoting personal safety practices at places of work.

Research and design methodology:

Petrochemical Industries were identified through snowball sampling, personal contacts and the internet, firstly to understand the acceptance, behaviour and reaction to protective clothing as a uniform and it's scope of identity generation. Secondary data was collected from various libraries.

Sample selection In order to gain an insight into the organisation and function of the petrochemical industry, people from different groups involved with protective clothing were selected by purposive sampling techniques. The total sample size comprised of 10 industries from Northern and Western India. A sample size of 200 respondents was interviewed based on convenient sampling method.

Tools and techniques of data collection
Interview Schedule designed for Workers(Appendix 1)
Observation - General status at the petrochemical industries, clothing needs.

Likert scale and open-ended questionnaires were used to gather information with respect to PC and the scope of identity generation. The following research questions were addressed in this study and evaluated using a 5 point Likert scale:

- How do employees perceive wearing Protective Clothing in petrochemical Industries?
- What are the main factors describing Protective Clothing or Personal Protective equipment?
- How can the workers be motivated to use Protective Clothing?
- What role do comfort and fashion play in the selection of Protective Clothing?
- How can we increase the acceptability of Protective clothing among the workers?
- Do the wearing and features of Protective wear influence overall job satisfaction?

The questionnaire is based on a Likert scale, and a few were open-ended questions. Likert scale questionnaires require each respondent to rate the statement on a 5-point scale. Scale 1 = strongly disagree, scale 2 = disagree, scale 3 = neutral, scale 4 = agree, and scale 5 = strongly agree. The questionnaire developed was attempting to measure the demographics, protective clothing influences on performance, protective clothing as a uniform, organisational identification, other job related data, and job satisfaction as well as several uniform features (such as style, appropriateness, functionality, material, color, comfort, etc.). The overall approach towards compliance of PC was measured.

Results and findings:

The data collected by interviewing the workers of petrochemical industries was analysed where the use of PC is compulsory. However in some places there is a problem of noncompliance, of not using PC even when a maintenance job is carried out at high temperatures, and involves handling chemicals. Many times the employees are not harmed by sheer luck. When asked about this, the usual answer is that PC is uncomfortable or boring. Hence these PC have to be improved by the use of modern fabrics that are comfortable. There is a need for comfort and fit that plays a part in durability, since garments that fit better wear better. The focus is on improving the look of PC to encourage the wearing compliance. To wear an industrial uniform workwear which is similar for workers and supervisors and other safety professionals, creates a sense of equality and identity. It was observed during the survey that this design of protective clothing worn is of level D according to OSHA guidelines, which is primarily

a work uniform. The results, conclude for the objective - working towards a global movement. The clothing should always be ergonomically designed for fit. With safety, comfort and fit, plays an important role. The choice of materials, design parameters, fiber and fabric properties all play critical roles in the design of protective clothing.

The participants who are serving in these petrochemical industries for many years will have a certain level of professional knowledge, maturity and ability to provide data for this research which showed in the Figure 1. Analyses were performed using SPSS software for Windows (version 25, 2007, IBM Corporation, Armonk, New York, United State).

The minimum age of the workers in the study was 18 years and the maximum age of the workers in the study was 59 years. The mean age of the workers in the study was 33.9±7.4 years. **Figure 1** gives age distribution of workers in the study. As seen in **Figure 1**, maximum workers in the study were between the ages of 25 – 40 years.

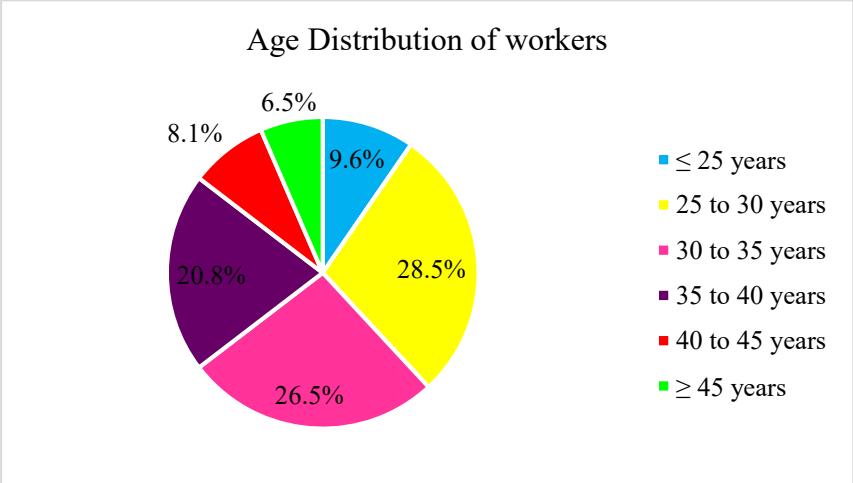

Figure 1: Age distribution of workers in the study (Data presented as percentage)

Educational qualification of the workers:

Figure 2 gives the educational qualification of workers in the study. As seen in Figure 2, 12.8% workers had completed <10th class of education, 27.7% had completed S.Sc., 23.6% had completed H.Sc., 33.8% were either graduates or had completed diploma whereas 2.1% had completed Masters level study (**Figure 2**). Thus, the maximum workers in the study had completed less than H.Sc. level of education.

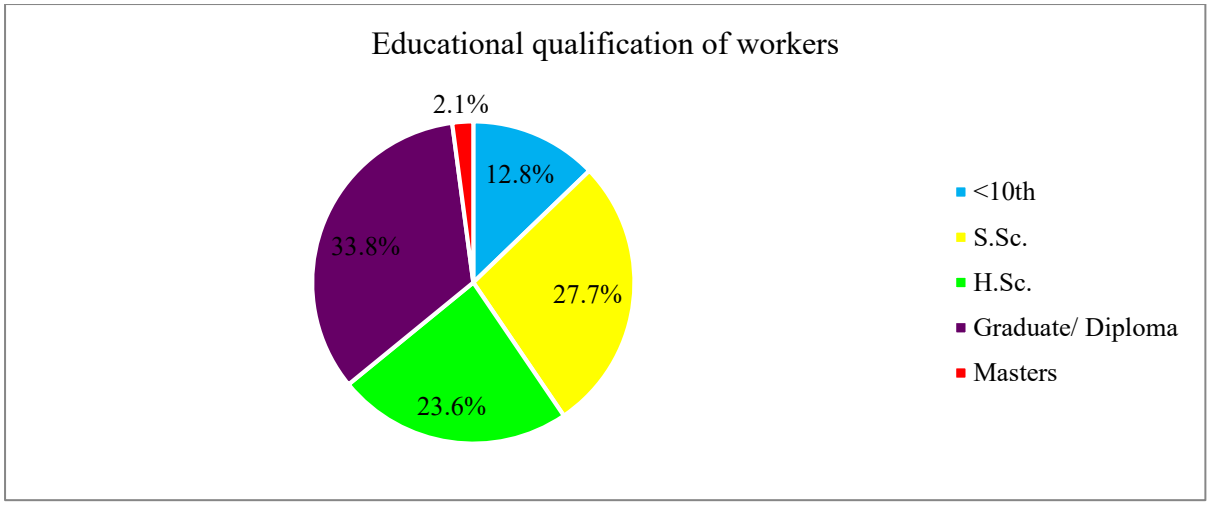

Figure 2: Educational qualification of the workers (Data presented as percentage)

Years of experience:

The minimum work experience of the workers in the study was 1 month, i.e. they had newly joined the company whereas the maximum work experience of the workers in the study was 35 years. On an average, works had an experience of 10.1±7.4 years. **Figure 3** gives the distribution of years of experience of the workers in the study. As seen in figure 3, 61% of the workers had less than 10 years of work experience whereas 38.8% workers had more than 10 years of experience.

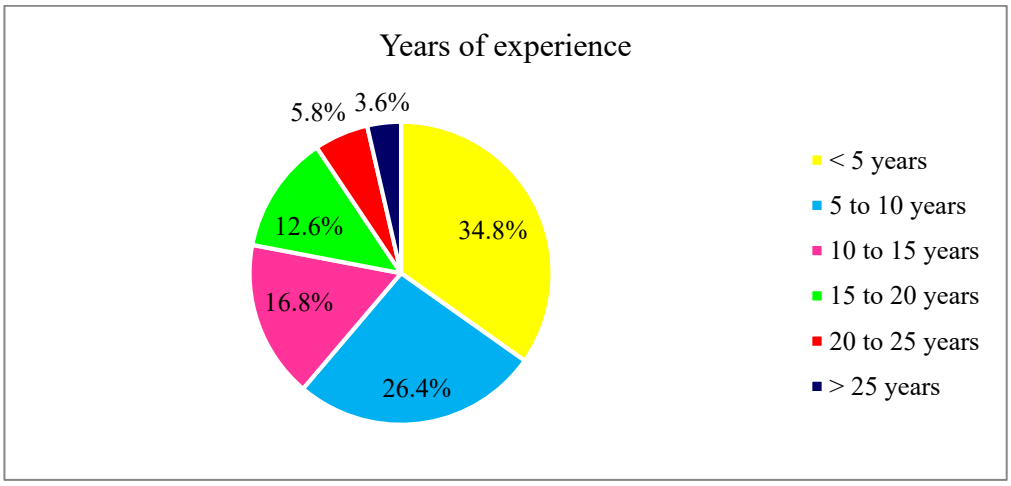

Figure 3: Number of years of experience of workers (Data presented as percentage)

Table 1 shows the level of awareness of the participants of using the Protective Clothing (PC). Based on the table, most of them were aware that PC is very important in the petrochemical industries. All the respondents were aware regarding the hazards that are present in the industries is as important as the usage of the protective clothing (Muhaimin, 2014). Supervisors are encouraged to wear protective clothing, moreover

it is followed up by the safety officer conducting the training of Personal Protective Clothing (PPC) for the workers. Based on the results, the industry safety departments had understand and supported that training had been regarded as one of the compulsory measures or requirements that the construction companies would have to provide for the workers, as well to ensure that the workers are well-equipped with the knowledge to carry out the work at the construction site with minimal safety hazards (Smith, 2014). Videos on various Indian safety standards were shown to the participants to create awareness. Hence all these attempts achieve the objective of promoting personal safety practices at work places.

Table 1: Workers & safety professionals, engineers' response to PC

Workers & Safety Professionals, Engineers Response To Pc	Mean Score	Rank	Rating
Compliance of PC by participant at petrochemical industries	4.89	1	Agree
Importance of PC	4.8	2	Agree
Training conducted	4.3	3	Agree
Design components suffice your requirements	3.78	4	Agree
Role of fashion in PC	3.5	5	Agree
(open ended questionnaire)What changes would you like to see in the PC with these characteristics?			

Table 2: Reason for non compliance of PC

Reason for non compliance of PC	Mean Score	Rank	Rating
Restriction of movement	4.5	1	Agree
Uncomfortable	4.5	2	Agree
Not given instruction	4.3	4	Agree
Creates disparity	4.5	3	Agree
Unattractive	4.3	5	Agree

The Group Identification Scale by Doosje et al. (1995) was used. This measure consists of three items (e.g. 'PC is our Uniform', 'PC gives us a unique identity', 'PC is comfortable'). Participants were asked to rate each item on a scale from 1 (totally disagree), to 10 (totally agree). The whole scale had a reliability of 0.71.

There is a necessity of workwear for workers in the petrochemical industries. Such workwear is a visible part of the corporate image, creating a role-based identity.

Fig. 4. Workers in Petrochemical Industry sporting uniform as part of protective clothing

Smart appropriate work uniforms are an essential factor from the perspective of occupational safety, and feeling comfortable at work. Success of a design is measured by the level of acceptance from the workers who use the clothing on a daily basis without supervision, or complaints about poor garment comfort, fit and style.

Fig. 5. Workers in the petrochemical industry sporting uniform as part of protective clothing

While conducting research with the participants from the petrochemical industries, and evaluating their identities, each one had a task assigned and had a different workwear, which created disparity in spite of similar educational qualification. Today, within some industries, irrespective of the hierarchy, all workers wear PC with uniformity. From an individual identity, to the role based identity, and, today a rising collective identity, a community is giving service to the world and has been shielded in the most fashionable attire.

Fashion has played a smart role in giving a boost to all employees in the industries visited, by providing a sense of belongingness irrespective of the hierarchy: one fashion identity for a group of people wearing PC with characteristics of comfort, functionality and safety with style. This is visible in figures 4 and 5, where one can observe that the uniforms have created a group identity for the wearers, based on identity through their work practices and clothing. For some this change is accepted; for others it is hard to accept as the demarcation of the different roles – the officer, or the frontline worker - is concealed by the smart uniform.

The study explored the attribution of uniform that can shape and distribute power to different groups of social actors on a basis of cultural representation as a symbol in industry. It covered the consequences of wearing protective workwear, and how identity perception is shaped by the workwear. It was also observed that wearing PC as part of a daily uniform created a sense of well-being and safety amongst the workers. Knowing that the uniform has the potential to protect them from various accidental hazards was assuring. These sensibilities are not restricted to a nation but have become part of a global phenomenon. Workers across all nations, who continue to wear protective clothing as part of a uniform for their safety, celebrate the same beliefs, values and commitment towards work. This creates a global belongingness as proposed in objective 3.

Conclusion:

Based on the results and data analysis, it can be concluded that the awareness and the effectiveness among the participants in the industry may not be high, but based on the ratings of the first and second objectives (tables 1 and 2) show that it is growing. It demonstrates that workers are aware of using personal protective equipment (PPE) and know the importance of PPE to reduce the scope of accidents and hazards. However it was observed that donning this protective clothing as part of their uniform in the industry, the workers sensed an enhanced feeling of safety and confidence. They could connect with the rest of the workers as promoters of safe industrial working practices. They could relate with their counterparts across the globe in similar industries as practitioners of right and appropriate working practices, aiming at preventing accidents in the industry.

Fashion has played its role, serving the industry by giving a design solution, which gives all employees an identity, irrespective of the role or task assigned, hence creating a community which stands out from groups of people outside the industry. The findings revealed that experienced workers, as well as less experienced workers have a great commitment towards compliance of PC while in the field, as mentioned by Mr Rathore (Head of Safety Department, Hindustan Zinc, Rajasthan, India).

‘Fashion provides one of the most ready means through which individuals can make expressive visual statements about their identities’. (Bennett, 2005)

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Appendix 1

Questionnaire (for the workers)

My name is Kundlata Mishra and I am conducting this interview as a part of my research on finding out about the compliance of Protective Clothing (PC) by users in the petrochemical Industries. The study focuses on understanding the acceptance, behaviour and reaction to Protective Clothing by the Workers. Also to analyse if PC brings a sense of belonging, and building a community that promotes well being and safety wear in industries. There is a need to create awareness of the need for protective clothing and to instill motivation for the proper use and maintenance of that protective Clothing. The protective clothing should be similar to the uniforms worn by the workers to ensure greater acceptability by them. Hence there is a need to do an assessment of the requirements of the protective clothing with reference to the functional utility and comfort and design. I would like to ask you some questions about your background, your education, some experiences you have had in the petrochemical industries. The interview should take about 10 minutes. Are you available to respond to some questions in this time?

1. Name:
2. Age:
3. Name of the Industry:
4. Type of Industry/Profile of the Industry:

5. Job Specified:
    i. Welding
    ii. Petrochemical Industry
    iii. Lathe Machine
    iv. Spray Painting
    v. Any other

6. Nature of Hazard:

    i. Flame/Fire
    ii. Oil and Grease
    iii. Paint(stain)
    iv. Electricity
    v. Any Other (Please specify)

5. Years of Experience in the Industry

i) < 5 years ☐
ii) 5 – 10 years ☐
iii) > 10 years ☐

6. Educational Qualification:
   i) < 10^{th} ☐
   ii) Diploma ☐
   iii) Technical Graduate/ Engineer ☐
   iv) Other Graduate ☐
   v) Any Other, Please Specify_____

7. Is the Protective Clothing acceptable to you /your unit? **Yes/No**

8. Do wearing and features of Protective Clothing influence overall job satisfaction?

9. How will you rate the aesthetic appeal of the garments?

	1	2	3	4	5
Looks of the Protective clothing- Does it gives a feeling of uniqueness and equality					
RATING SCALE :scale 1 = Highly Dissatisfactory, scale 2 = Dissatisfactory, scale 3 = Satisfactory, scale 4 = Moderately satisfactory, and scale 5 = Highly satisfactory					

10. Do you find the design features correct for functional utility?

	1	2	3	4	5
Design features in Protective Clothing					
RATING SCALE: scale 1 = Highly Dissatisfactory, scale 2 = Dissatisfactory, scale 3 = Satisfactory, scale 4 = Moderately satisfactory, and scale 5 = Highly satisfactory					

11. How do you find fitting of the garments with respect to ease of movement while working?

	1	2	3	4	5
Fit of Protective Clothing					

RATING SCALE: scale 1 = Highly Dissatisfactory, scale 2 = Dissatisfactory, scale 3 = Satisfactory, scale 4 = Moderately satisfactory, and scale 5 = Highly satisfactory

12. Rate the Protective Clothing in terms of comfort while Working:

	1	2	3	4	5
Comfort of Protective Clothing					
RATING SCALE: scale 1 = Highly Dissatisfactory, scale 2 = Dissatisfactory, scale 3 = Satisfactory, scale 4 = Moderately satisfactory, and scale 5 = Highly satisfactory					

13. How do you perceive wearing Protective clothing in petrochemical industries?

	1	2	3	4	5
Protective Clothing gives an identity					
RATING SCALE :scale 1 = Highly Dissatisfactory, scale 2 = Dissatisfactory, scale 3 = Satisfactory, scale 4 = Moderately satisfactory, and scale 5 = Highly satisfactory					

14. What are the main factors describing Protective Clothing or Personal Protective equipment?

15. How can the workers be motivated to use Protective Clothing?

16. How can we increase the acceptability of Protective clothing among the workers?

17. Is the Protective Clothing designed cost effective? **Yes/No**

18. Any Suggestions towards the compliance of PC and for its improvement?