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“Respiratory Health Risks from Revolutionizing Textiles; from Soy and Its Products”

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Abstract

The trepidation of the deteriorating environmental conditions caused by the reckless use of chemical products has triggered worldwide efforts to create eco-friendly fibers. The ever-expanding range of textile fibers has the aim of drastically reducing the global consumption of harmful, non-biodegradable, eco-friendly products. The main goal of the textile industry is to be eco-conscious. Due to their widespread use as animal feed and in a wide variety of human food products, soybeans and their processed forms have grown in importance in agriculture. Increasingly, clothing companies are offering clothes made with eco-friendly fabrics. There is a growing concern about the deteriorating environmental conditions caused by the irresponsible use of raw materials. Demand for eco-friendly clothing is also on the rise. Eco-friendly fibers can be used as whole or as part of materials and products in various forms and performance characteristics for a wide range of applications. As the world's environment continues to deteriorate, it is essential to step up the space of research in the development and use of eco-friendly fibers. But the concern is, it contains several known allergenic proteins; soy is acknowledged as a dietary allergy. Respiratory health issues are also caused by inhaled soy dust from work-related activities. According to reports of "asthma epidemics" in harbor cities, occupational activities involving the loading and unloading of bulk soy without the proper dust control procedures were linked to community health issues. Occupational asthma (OA) is one of the many allergy symptoms that can be brought on by inhaled allergens in those who are already sensitized. Lung irritation is another health issue associated with soybean dust. Additional possible respiratory risks are endotoxins and fungal contaminants linked to soy. The amounts of exposure to dust and significant allergens from a variety of occupational tasks are reviewed, together with data on

illnesses and symptoms resulting from airborne exposure to allergens in dust from soybean and derivative products. Additional possible health risks linked to soybeans are also emphasized, including endotoxin and fungal contamination.

Key Words: Eco friendly Fibers, Health hazards, Respiratory Hazard, Clothing.

1.Introduction

The use of sustainable and eco-friendly fibres and renewable raw materials has grown in popularity in recent years due to growing environmental consciousness. Finding innovative and biodegradable textile fibres is vital because the production of many synthetic fibres pollutes the environment and contributes to global warming. Because they are made from the leftovers of soybean oil, tofu, or soymilk, soy-based textiles are much more biodegradable and regenerable than synthetic ones, which take years to break down. Additionally, soy-based fabric is an affordable substitute that offers varied, high-quality performance, unlike natural protein fibres like wool and silk, which can be expensive and have restricted performance. For example, animal fibres shrink when washed and are difficult to colour. Its very moisture-absorbent and colourfast qualities make it ideal for dyeing and allow it to be pulled to any desired fineness. In addition to the fact that soybean fibre is rich in beneficial amino acids that support good skin, soy fabric is a popular option for sportswear since it is UV-resistant, antibacterial, and breathable. Actually, the athleisure company KD New York makes yoga, dance, barre, and ballet workout attire with cashmere derived from soy. Pure soy fabric, which is manufactured from processed soy proteins and is breathable and elastic, is one of the many types of fabrics developed from soy components. For increased durability, soy can also be combined with other materials to make soy cotton mixes. Additionally, soy can be combined with other materials to make soy cotton blends, which offer improved durability, a silky sheen, and strength similar to cotton; and soy wool blends, which preserve the softness and flexibility of soy fabric while utilizing the insulating and long-lasting qualities of wool⁽¹⁾.

Japan ⁽²⁾ and the United States ⁽³⁾ made the initial attempts to turn soybean protein into textile fibres. Oil was extracted to produce an oil-free meal, proteins were extracted from the meal using alkali, alkaline proteins were dispersed, fibre was formed by passing through a spinneret into an acid coagulating solution, and post-spinning treatments were all part of the wet-spinning process. However, because the fibres lacked useful qualities, they were never produced commercially. Because of its low cost and ease of processing, petroleum emerged as the primary source of synthetic textile fibres following World War II, undermining the economic prospects of synthetic protein fibres. But during the past ten years, there has been a resurgence of interest in soybean fibre because of environmental concerns, and a production line has already been set up in China ⁽⁴⁾. Natural protein fibres like silk and wool have good physical qualities and are widely used in the textile industry. Soybean fibre, on the other hand, has no theoretical limit to the fineness at which fibres can be drawn. Additionally, because it is inexpensive and plentiful, soybean is a competitive source of fibre production in the textile industry. This review research concentrated on published data pertaining to the respiratory risk posed by soy fiber-related airborne dusts.

2. Textile Dust's Risk to Respiratory Health

Acute respiratory failure, respiratory infections, and chronic respiratory illnesses are all threats to respiratory health. Smoking, air pollution, and other environmental variables can all contribute to these risks. Risk elements derived from lung disease risk is increased by tobacco use, especially secondhand smoking. Respiratory illnesses can be brought on by indoor and outdoor air pollution from sources such as solid fuel cooking. Lung disorders can be made more likely by exposure to radon, asbestos, arsenic, and other dangerous substances. Lung disease is more likely to occur in those with diabetes, heart disease, and other illnesses. Acute respiratory failure can result from drug and alcohol overdoses that impact the part of the brain responsible for breathing. effects on respiratory health, Breathlessness, wheezing, coughing, discomfort in the chest, a raspy voice, weariness, weakness, and lower body oedema, Blue, grey, or light-colored skin, lips, or nails. Respiratory conditions include lung cancer, pulmonary fibrosis, pneumonia, asthma, and chronic obstructive pulmonary disease (COPD).

Additionally, byssinosis (cotton dust), occupational asthma, and respiratory irritation can be caused by textile process dusts, especially those involving wool and cotton. When dust is a danger, the following should be prioritized: current COSHH assessments, control to within Workplace Exposure Limits (WELs), and basic health surveillance. Backwinding, carding, blending, and opening are common dusty procedures in the wool industry. The majority of early cotton processes, such as raw material handling, opening, carding, drawing, combing, beaming, ring spinning, and high-speed winding, are probably going to need control methods. Instead of using a broom, brush or compressed air, you should use a Hoover cleaner.

Byssinosis, a chronic respiratory condition, has long been linked to cotton dust exposure. The length of time a person is exposed to dust and the levels of dust in the air are factors that affect the disease's incidence. The majority of instances are linked to early processing stages where dust concentrations are often greater. Which dust component-or components-causes the illness is unknown. However, the condition is less common when bleaching or other moist treatments are used. The illness linked to wool dust exposure is not as clearly defined. Common symptoms include persistent rhinitis (runny or stuffy nose), chronic conjunctivitis (itchy or irritated eyes), chronic bronchitis, and dyspnea. The frequency of these symptoms is correlated with both the amount of dust in the air and the length of time an individual has been exposed. There doesn't seem to be any connection to any specific wool processing step. Which dust component or components causes the illness is unknown. With the following exceptions⁽⁵⁾:

- Dust from weaving, knitting, braiding, and other processes;
- Dust from bleached or dyed cotton; and
- Dust from finished items

such as clothing, the WEL for cotton dust is 2.5 mg/m³ (8-hr TWA) and pertains to exposure to inhalable dust during handling of raw and waste cotton, including blends containing raw or waste cotton. Wool process dust has a MEL of 10 mg/m³ (8-hr TWA). The dust produced during the manufacturing of

woollen and worsted textiles is referred to as "wool process dust." In the case of carpet manufacturing, this covers all factory operations from the time raw wool is received until the final product is produced, including the production of knitted, woven, and non-woven fabrics. It excludes any sorting or baling that takes place on the farm, among other agricultural operations. 'Wool' in this context refers exclusively to sheep's wool and wool blends. It excludes other specialized fibres like alpaca, camel, or goat hair (including cashmere and mohair). The structure of these fibres is different from that of wool, and it is uncertain if the dust's composition or possible health risks are the same as those of wool process dust ⁽⁶⁾.

2.1 Management of Dust Exposure

While it is impossible to completely eradicate process dust from mills, it could be feasible to lessen the amount of dust generated. Depending on the raw material's quality, how it is treated, and the procedures it goes through, batches of cotton and wool might have varying levels of dustiness. When implementing new procedures or machinery or altering current ones, one of the goals should be to reduce dust.

Reduced dust exposure must be accomplished without the use of respiratory protection equipment (RPE) if it is practically possible. Using LEV to control dust escaping from critical apertures after enclosing machinery as much as feasible is frequently the most effective strategy. The accumulation of elevated background dust levels can be avoided with adequate general ventilation. Reducing exposures can also be achieved by keeping employees away from the process, such as by avoiding the need for them to enter blending bins or, when practical, by putting them in booths that are fed filtered air.

It is strongly discouraged to clean machinery by "flapping down" with cardboard or by using compressed air because this might disturb settled dust and produce high amounts of dust. Using a piped Hoover system or a type H cleaner designed for industrial use are preferable options. Dust generation can be minimized by first misting the floor with water if brushing floors is unavoidable. Depending on whether the fan is clean or unclean, the filters in dust collection systems will be under positive or negative pressure. Because any leak in the filter will allow dust to be blown into the working area, positive pressure (blown) filters should be contained or housed in a separate filter chamber. Workers shouldn't be exposed to much more air once it has been returned from a dust collector to a workroom. It could be necessary to use electrostatic precipitators, water spray scrubbers, or a high efficiency secondary filter to further lower the dust concentrations in returned air. Expert assistance is necessary to choose the best course of action.

Dust collectors should be emptied with the system turned off and in a way that stops dust from escaping, unless the system is made with rotary valves that may be emptied while it is operating. Using a disposable bag in a collector bin is one choice. Dust collector emptying is an extremely dusty operation, and if dust cannot be sufficiently controlled throughout the emptying process, RPE should be worn. The performance of filter systems will decline if frequent emptying and maintenance are neglected, making the eventual emptying process considerably more challenging and dustier.

2.2 Protective gear for the respiratory system

Only after dust levels have been lowered as much as is practically possible through other means can respiratory protection equipment be employed. Long-term costs should be utilised to determine the relative costs of RPE and engineering controls. RPE may have relatively modest initial costs, however replacement and maintenance costs must be included in. Although circumstances will differ, RPE is frequently the more costly choice based on equipment lifetime expenses. Filtering face-piece respirators (also known as "disposable" or FFP), half-mask respirators, or powered visor respirators are often the options available if RPE is required.

Sites that it satisfies EU regulations and typically complies with a European Standard. If it is still serviceable, equipment that was manufactured prior to July 1995 and was HSE "type approved" may still be utilised. Equipment that minimises exposure to the lowest amount that is practically practicable should be selected because cotton and wool process dusts are subject to a MEL ⁽⁷⁾.

2.3 Control Mechanisms

Over time, wear and physical deterioration cause all engineering control methods to function worse. They ought to be visually inspected at least once a week, if at all possible. They should also undergo appropriate testing and a thorough examination on a regular basis. These intervals shouldn't exceed 14 months for LEV plants. Documents must be preserved for a minimum of five years. Additional guidance is provided in HSE booklet HS(G) 54, the COSHH General ACOP4 and the upkeep and testing of local exhaust ventilation ⁽⁷⁾.

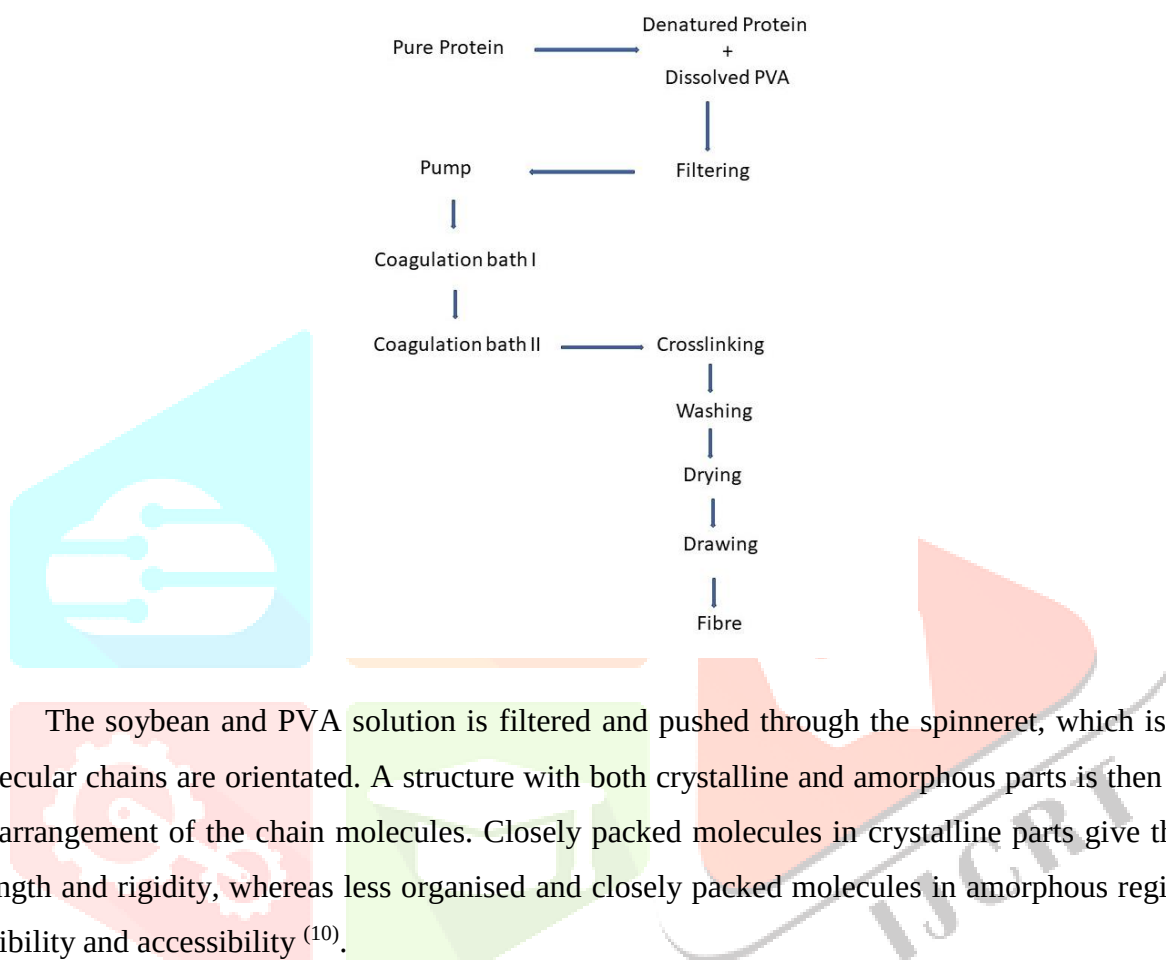
Every time respiratory protection equipment is utilized, the user should visually inspect it. According to the manufacturer's recommendations, non-disposable equipment should be inspected in detail, fixed, and tested as necessary at least once each month. Documents must be maintained. HSE booklet HS(G) 53 provides more details. A useful manual for users of respiratory protection equipment ⁽⁸⁾.

3. Soy Dust's Risk to Respiratory Health

Bulk unloading of soybean grains may result in the creation of soybean dust. Particularly for those who are already sensitive or have other medical disorders, it might lead to respiratory problems and other issues. 36% protein, 20% fat, 30% carbs, 9% water, and 5% ash make up dry soybeans. Antioxidants, fibre, and omega-3 fatty acids are also abundant in soybeans. They are cholesterol-free and low in saturated fat. Among other things, respiratory disorders can be brought on by soybean dust. It is more likely to affect people who are already sensitive or who have other medical concerns. The likelihood of being impacted is higher for those who are already sensitive or who have other medical concerns. Breakfast cereals, canned tuna meat, low-fat peanut butters, high-protein energy bars and snacks, breads, cookies, crackers, tinned broths and soups, and processed meats all contain soy. The way that soy products are prepared and the additional ingredients that are added can affect their nutritional value. People who have had kidney stones

in the past should not eat a lot of soy. Soy products may also cause sensitivity in children with severe cow's milk allergies ⁽⁹⁾.

The original state of soybean protein is globular, making it unsuitable for spinning. It must therefore be denatured and degraded in order to transform the protein solution into a dope that can be spun. Figure 1 depicts the production process for soybean fibre.



The soybean and PVA solution is filtered and pushed through the spinneret, which is where the molecular chains are orientated. A structure with both crystalline and amorphous parts is then formed by the arrangement of the chain molecules. Closely packed molecules in crystalline parts give the material strength and rigidity, whereas less organised and closely packed molecules in amorphous regions give it flexibility and accessibility ⁽¹⁰⁾.

The two successive coagulation baths of sodium sulphate and ammonium sulphate in water with 1M sulphuric acid preserve the orientation to a high degree. The initial and final coagulation baths are kept at 50 and 70 degrees Celsius, respectively, depending on the PVA's spinning conditions. Depending on the coagulation rate and the soybean/PVA combination, the fibres' cross-section is determined ⁽¹¹⁾.

3.1 Soybean and its Byproduct Hazards

An annual legume belonging to the Fabaceae family of peas, soybeans have edible seeds. Because flours from different cereals tend to be "dusty," it is important to control how they are handled to avoid airborne exposure to flour dust and the resulting health impacts. In food processing, soy flour is being used more and more. Soy flour has been shown to have allergens that have been recognised and described ⁽¹²⁾. A summary of the respiratory risk factors that are both extrinsic and intrinsic in soybeans Although the next section discusses intrinsic, particular allergenic proteins, other "contaminants" or extrinsic material may be linked to soy products and could cause respiratory symptoms or disorders if inhaled. Hypersensitivity

pneumonitis (HP), often referred to as extrinsic allergic alveolitis (EAA), is another allergy-causing condition that can be brought on by *Aspergillus* and *Penicillium* species. Conidia (spores) carrying allergenic proteins, such as Asp f 1, can be produced in large quantities by *Aspergillus fumigatus*, the most common opportunistic fungal pathogen that can be fatal in immunocompromised humans. However, a number of *Aspergillus* strains, notably *A. oryzae*, are employed in the regulated fermentation of soya to create soy sauce. This fungus source's alpha amylase is employed to enhance cereal flour and is linked to a considerable increase in baker sensitization⁽¹³⁾. If the particles are fine enough, organic dust that has no discernible harmful qualities can irritate and inflame the lungs. Larger dust particles will be expelled from the body after being lodged in the throat or nasal tube.

Significant lower respiratory tract symptoms can be caused by particles with an aerodynamic diameter of less than 10 µm entering the lungs through the bronchus and particles smaller than 4 µm reaching the alveoli deep within the lungs. According to the little evidence, soy dust may be affected by this mechanism⁽¹⁴⁾. EAA is a separate disease entity linked to particles smaller than 5 µm, as is Organic Dust Toxic Syndrome (ODTS)⁽¹⁵⁾. Particle diameters of 5–10 µm typically trigger asthmatic symptoms⁽¹⁶⁾. The health effects of exposure to intrinsic soy allergens are the one aspect of these extrinsic and intrinsic variables that may be related to soy that has substantial scientific support.

3.2. Soy-based allergens

Research that has been published on the effects of soy dust exposure on health A previously sensitized person may have a variety of symptoms affecting their eyes, nose, upper and lower respiratory systems, including the onset of occupational asthma (OA), if they are exposed to an allergen in the air again. Airway hyperresponsiveness and fluctuating airflow limitation are hallmarks of OA, a disease brought on by a specific work environment. Two primary categories of OA are recognized⁽¹⁷⁾.

Usually requiring IgE-mediated immunological sensitization to allergenic proteins, immunological OA arises following a latent period of exposure during which the worker develops sensitization to the causative factor. Non-immunologic OA is typically brought on by irritating mechanisms linked to the cumulative effects of dust or chemical exposure at work. A person may become permanently disabled or be unable to continue working in that workplace due to the severity of either type of OA. 1934 saw the publication of the first report describing a soy allergy linked to dust from a soybean mill⁽¹⁸⁾. A report of both immediate and late-onset OA in a previously non-allergic person exposed to soy flour in the production of dietary supplements was published in 1977⁽¹⁹⁾. Workers in a range of vocations, including farmers, millers, soybean processors, and bakers, have been linked to OA or other respiratory health issues as a result of exposure to soy dust and flour⁽²⁰⁾.

3.3. Limiting Exposure to Soy Dust

The Barcelona data unequivocally demonstrates the importance of limiting soy dust emissions when unloading bulk soy. These actions significantly reduced the measured quantities of soy in the air and

ultimately ended asthma epidemic outbreaks that were severe enough to result in mortality ⁽²¹⁾. Even still, outbreaks continued in 1994 and 1996 despite the initial control measures being put in place in 1987. In 1998, the storage silos were equipped with even more powerful particle-retaining filters. Aeroal largens aerial monitoring, which began in Barcelona in 1986, has proven to be valuable.

Although soy is not a cereal, several international regulatory and authoritative authorities have acknowledged the health risks associated with grain dust, and some have specifically included soy in their definition of grain dust ⁽²²⁾ or emphasized how dust from grain and soy has equal internal and extrinsic risks ⁽²³⁾. Grain dust occupational exposure limits range from 1.5 to 10 mg m⁻³ 8 hour TWA, according to several regulatory and authoritative agencies in the USA, Canada, and Europe. Because soy is a respiratory sensitizer, the Control of Substances Hazardous to Health (COSHH) Regulations require risk assessments, control soya exposures to as low as reasonably practicable, and implement appropriate health surveillance. This is in addition to Great Britain's 10 mg m⁻³ (gravimetric measurement) exposure limit for grain dust. Gravimetric dust monitoring is not always a reliable indicator of the level of exposure to endotoxins or soy allergens. Our two studies on the dock ⁽²⁴⁾ found that even in a very limited number of bulks, gravimetric measurements barely explained 50–70% of the range in the airborne levels of the two allergens studied.

The respiratory-sized fraction produced by drum dustiness testing does not show a strong correlation between the amounts of allergens (HSP and STI) and gravimetric dust ⁽²⁵⁾. The second dock study conducted by HSE revealed that only between 29–57% of the difference in endotoxin levels across the two sample days could be explained by gravimetric dust readings. The health concerns associated with dust exposure from grain flour in bakeries have been thoroughly studied ⁽²⁶⁾. There are numerous ways to lessen the exposure of bakers, including engineering control, local exhaust ventilation, labour activity adjustments, and training [6, 70, 81, 101–103]. Such steps to lower flour levels in the air should also lessen exposure to soy flour dust. Remarkably, adding soy oil has been proposed as a way to lessen the dustiness of some flours, such as in improver mixes ⁽²⁷⁾.

4. Conclusions

It is commonly known that soy is essential to the worldwide diet of both people and animals. It is primarily grown in the United States or South America, and it is handled, processed, transported, and used by a wide range of end consumers. In addition to those who are directly exposed at work, people in the general public and textile sectors who are indirectly exposed through agricultural and occupational activities have also been reported to have health issues as a result of soy dust exposure. Workers in the textile sector, the production of fibre for clothing, stevedores, farmers, millers, bakers, and food processors may be exposed to soy dust. Bakers who have experienced severe allergy reactions and occupational asthma due to grain flour are probably going to benefit from the controls put in place to limit dust exposure to soy. Soy dust appears to be directly or indirectly covered by regulatory regimes that address respiratory difficulties caused by grain dust exposure. Setting gravimetric workplace exposure limits is one way to implement such measures, albeit there isn't always a clear correlation between the amount of dust in the air

and its allergen concentration. In the UK, COSHH for asthma is more regulated, including for soy. This requires companies to use adequate health surveillance, conduct risk assessments, and limit exposure to as little as is practically possible. However, it goes without saying that the effectiveness of such a regulatory system depends on how it is applied in cases when soy is present.

Reference:

1. Beyond Food_Soy-Based, Sustainable Fashion - U.S. Soy.pdf
2. Kajita, T. and R. Inoue (1940), Process for Manufacturing Artificial Fiber from Protein Contained in Soybean, U.S. Patent 2,192,194. Kajita, T. and R. Inoue (1940b), Process for Manufacturing Artificial Fiber from Protein Contained in Soybean, U.S Patent 2,198,538.
3. Huakang Ltd. (2005), www.soybeanfibre.com.
4. Agricultural Statistics Board (1990), Agricultural Prices Report, NSSA, USDA
5. Cook, J. G. (1984), Handbook of Textile Fibres, Watford, England, Merrow Publishing Co.
6. Zhang, X., B. Min and S. Kumar (2003), Solution Spinning and Characterization of Poly (vinyl alcohol)/Soybean Protein Blend Fibers, Journal of Applied Polymer Science, 90(3):p.716.
7. Boyer, R. A., W. T. Atkinson and C. F. Robinette (1945), Artificial Fibers and Manufacture Thereof, United States Patent, 2,377,854.
8. Carter, M. E. (1971), Essential Fiber Chemistry, New York, Marcel Dekker.
9. Fraenkelconrat, H. and H. S. Olcott (1948), The Reaction of Formaldehyde with Proteins 5. Cross-Linking Between Amino and Primary Amide or Guanidyl Groups, Journal of the American Chemical Society, 70(8):p.2673-2684.
10. Petersen, H. (1987), Chemistry of Crease-Resist Crosslinking Agents, Review of Progress in Coloration, 17:p.7-22 (Petersen, 1987; U.S. Environmental Protection Agency, 1987; Monticello et al., 1989)
11. TS 391 EN ISO 9237 Textiles-Determination of Permeability of Fabrics to Air, 1999.
12. BS 3449 Testing The Resistance of Fabrics to Water Absorption (Static Immersion Test)
13. Harris-Roberts J, Robinson E, Fishwick D, Fourie A, Rees D, Spies A, et al. (2012) Sensitization and symptoms associated with soybean exposure in processing plants in South Africa. American Journal of Industrial Medicine. 55:458-464
14. Zuskin E, Kanceljak B, Schachter E, Witek T, Marom Z, Goswami S, et al. (1991) Immunological and respiratory changes in soy bean workers. International Archives of Occupational and Environmental Health.; 63(1):15-20
15. Seifert S, Von Essen S, Jacobitz K, Crouch R, Lintner C. (2003) Organic dust toxic syndrome: a review. Journal of Toxicology. Clinical Toxicology;41:185-193
16. Horner W, Helbling A, Salvaggio J, Lehrer S. (1995) Fungal allergens. Clinical Microbiology Reviews.8(2):1 61-179
17. Tarlo S, Lemiere C. (2014) Occupational Asthma. The New England Journal of Medicine. 370(7):640-649

18. Duke W. (1934) Soybean as a possible important source of allergy. *Allergy*. 5:300-302
19. Bush R, Cohen M. (1977) Immediate and late onset asthma from occupational exposure to soy bean dust. *Clinical and Experimental Allergy*. (4):369-373
20. Cummings K, Gaughan D, Kullman G, Beezhold D, Green B, Blachere F, et al (2010). Adverse respiratory outcomes associated with occupational exposures at a soy processing plant. *The European Respiratory Journal*. 36:1007-1015
21. Rodrigo M, Cruz M-J, Garcia M, Anto J, Genover T, Morell F. Epidemic (2004) asthma in Barcelona: An evaluation of new strategies for the control of soybean dust emission. *International Archives of Allergy and Immunology*. 134:158-164
22. Dutch Expert Committee on Occupational Standards. Grain Dust: Health-based recommended occupational exposure limit. The Hague: A Committee of the Health Council of the Netherlands; 2011
23. Health and Safety Executive. Grain Dust: Guidance Note (Third edition) EH66. HSE; 2013. Available from: www.hse.gov.uk/pubns/eh66.htm
24. Mason H, Gómez-Olles S, Cruz M-J, Smith I, Evans G, Simpson A, et al (2015). Levels of soya aeroallergens during dockside unloading as measured by personal and static sampling. *Archives of Industrial Hygiene and Toxicology*. 66:23-29
25. Mason H, Gómez-Olles S, Cruz M-J, Roberts P, Thorpe A, Evans G (2017). Quantifying Dustiness, Specific Allergens and Endotoxin in Bulk Soya Imports. *Environments*. 4(4):76
26. Griffin P, Fishwick D, Elms J, Curran A. (2001) Respiratory symptoms and wheat flour exposure: a study of flour millers. *Occupational Medicine*. 51:141-143
27. Mason H, Fraser S, Thorpe A, Roberts P, Evans G. (2017) Reducing dust and allergen exposure in bakeries. *AIMS Allergy and Immunology*. 1:4194-4206