Indoor Air Quality Between Textiles' Treatment And Human Health

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Abstract: Indoor air quality is a global demand and one of the most important benefits in achieving the principles of sustainability. Textiles used in interior spaces such as beds' and seats' covering, , curtains, carpets and interior decoration as well as thermal insulation or protection from moisture considered one of the reasons for indoor air pollution. These textiles were treated by poisonous chemicals in dyeing, printing and finishing processes to impart a required functional property to the fabric such as making cotton fabrics wrinkle free, flame retardant, water repellent, waterproof, anti-static, anti-bacterial.. etc. Interior textiles were subjected to different types of physical and chemical treatments in which these treatments may be emitted in indoor spaces due to factors of air movement, temperature rise and friction. Thus, the intensive usage of these textiles within the indoor spaces may affect indoor air quality. Research problem can be stated in the modern technology of textile treatment used in interior spaces which has a detrimental effect on indoor air quality. Also, are there some methods that must be followed to reduce pollution emitting from these fabrics? and Are there some fabrics should be forbidden in some internal spaces which may depend on the internal space itself, number of ventilation times inside the space and activities that are practiced within the space? This research aims to determine the amount of pollutants that may be spread in the internal space resulting from the uses of treated textiles through surveys and analytical studies.

Index Terms: Indoor Air Quality, Indoor Air Pollutants, Textiles' Treatment, Sustainability, Human Health, Furnishing textiles, Toxic materials.

1 INTRODUCTION

Textiles are the important used materials in the overall interior spaces within the buildings especially residential including furnishings, curtains, carpets/rugs, upholstery and wall coverings. They comprise the largest area of all surface areas in the indoor environment as they combined large areas of flooring, walls, ceiling furniture, and accessories. Most of interior designers preferred textiles for interior operations, as they are the fastest material that can be changed in home furnishings and decorations. They are a simple quick way to change the shape of a certain area and create a new one; when customer feel bored and want to renew. Textiles also have a role in organizing the lighting of a certain place through curtains. Most of recent uses of interior textile products required modification in some functional and aesthetic properties of fabrics by introducing chemical compounds which contain toxic substances that have been shown to have deleterious impacts on air quality (1). Exposure to hazardous substances in textiles of interior fixtures and furnishings; and residues from dyeing and printing process exist in latent forms which may be emitted and degrade increased risk of cancer and developmental disorders (2). Our modern life requires the use of chemicals, compounds and materials which are very harmful to both of human health and environment. Although we are aware by the hazards of some of these materials, we cannot dispense them in our daily lives. Persistent exposure and prolonged use of hazardous substances in textiles has deleterious impacts on human health which causing many diseases as asthma and allergies (3).

2 INDOOR AIR POLLUTANTS

Air quality in the indoor environment of buildings is affected by different types of contaminants which may be biological, chemical, radioactive, and electromagnetic or dust. They may result from human activities in the indoor area, the use of electrical appliances, materials used in construction, furniture, interior finishes and interior space supplements, As well as pollutants coming from the surrounding environment of a building (outdoor environment) that creeps into interior space through architecture openings or cracks in buildings.

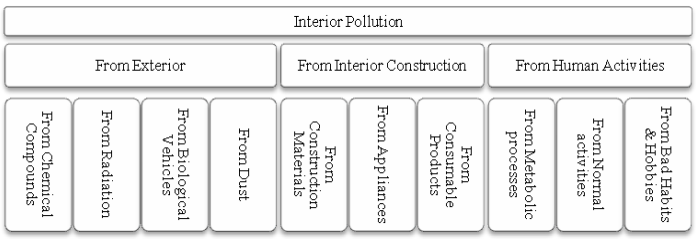

***Fig. 1**. A table of Indoor air pollutants*

3 TEXTILE IN INTERIOR SPACES

Generally, interior textile products and furnishing are originally created for functional and practical purposes; and are used to cover and some interior elements. (4) There are basic criteria humans should be aware when using textiles in indoor environment such as the type of textiles, duration of dealing with them, for any indoor area will be used and extent of quality and dealing in terms of cleaning, maintenance and colour stability for safety uses of the fabrics.

3.1 Interior textiles Finishing and Treatment

The essence of interior textiles finishing is to improve the physical, visual, performance and aesthetic properties which have positive influence on consumers, effect on human well-being and enable the qualified use of the treated textiles (5). Finishing operations involve the use of strong, potentially harmful chemicals which release toxic substances affect the indoor environment (3) & (6). The main processes generally carried out in three stages involved:

- Pretreatment: singeing, desizing, scouring, mercerizing, and bleaching.
- Coloration: dyeing, printing.
- Functional finishing: applied through coating/impregnating to make the textiles of

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acceptable level of in-use performance.

Mostly, the textile finishing process is combined with a manufacturing process which gives particular shape and distinctive properties to the final product. Sometimes, textile-based materials are coated or bonded and sprayed with specialty chemicals to improve various performance properties as per the required applications (7). Key functional finishing processes for interior textiles include:

3.1.1 Acoustic finishes for interior textiles

Acoustical textiles used to absorb sound or as a cover for acoustical panels (textiles for sound insulation purpose). The acoustic interior textile material may be acoustic carpets, acoustic curtains, acoustic sofa covers, acoustic interior textile hangings, acoustic floor coverings, acoustic textile nonwovens mainly used in interlining, acoustic coated textile fabrics and acoustic textile composites (8). Factors have significant influence on acoustic properties of textiles such as the textile structure, fibre fineness, number of pore and its size. The types of fibre (natural and synthetic) and its combinations can enhance sound absorption properties, High density fabrics yielded better sound insulation, (absorb sound of high frequency) (9).

3.1.2 Flame-retardant finishes for interior textiles

Interior textiles can have their fire resistance by treatment with fire-retardant chemicals. The function of flame-retardant finishes developed specifically for cellulose, wool, man-made fibres (10). This finishing is important in the furniture sector for upholstery fabric, carpets/rugs, wall covering fabrics and curtains. Textile products with flame-retardant properties are achieved by the application of toxic chemical substance, which either used as additives or are react with the textile. There are various approaches to use flame retardant as additives including:

- Through spinning solution, specific chemicals can be added during fibre manufacturing.
- Create flame-retardant properties with the development of modified fibres.
- Back-coated of finished textile articles e.g. furniture; in which a fire-resistant layer is attached to one surface of the textile.

3.1.3 Antimicrobial finishes for interior textiles

All articles of home textiles are susceptible to problems of hygiene in normal daily use, e.g. floor coverings (carpets/rugs). Antimicrobial finishing of textiles inhibiting the growth of microorganism which may be harmful to human being. It is emerged as technical products for hygiene control and healthcare (11). Fabrics with antimicrobial effect can be achieved through several methods including:

- Application of specific chemicals during the finishing stage (fabric impregnation treatments, and coatings).
- Incorporation of antimicrobial substances into chemical fibers during the spinning process (12).
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3.1.4 Colour fastness property for interior textiles

Interior textiles are required to perform to a level suitable for its end use and include any requirements for aftercare in order to maintain appearance and to last the lifetime of the product. The performance requirements of interior textiles are dictated by standards set out by the consumer (13). Designers in this field need to consider fabric type and dye/pigment action in order to meet colour fastness requirements for textiles so they do not fade. Colour fastness is the resistance of dyed/printed textiles to colour change during/after a particular factor. The key common to interior textiles are fastness to; Wet and dry rubbing/crocking, light and detergent washing. For improved colour fastness, the dye must possess a stable aromatic structure e.g. azo dyes; and adding of textile auxiliaries which are essential to the dyeing process e.g. catalysts, dye carriers and dispersing agents (14). Exposure to some azo dyes has been related to the development of bladder cancer, splenic sarcomas, hepatocellular carcinomas, cell anomalies (15).

3.1.5 Repellent finishes for interior textiles

Repellent finishing is the ability acquired to textiles to prevent water and oils from sticking to the fiber surface. Oil, soil and durable water repellent require very low surface tension of the fabric through treatment by fluorochemical polymer and silicon. Repellent finishes are particularly important for interior textiles e.g. upholstery fabrics, carpets and rugs; that are not routinely laundered (16). Using of C8 fluorocarbon in repellent finishing has been classified as a substance of very high concern because it has persistent, bio-accumulative, and toxic properties (17), after using a certain time it releases perfluorooctanesulfonate (PFOS) and perfluorooctanoic acid (PFOA) which are hazardous materials (18).

3.1.6 Thermal insulation for interior textiles

Thermal insulation is the prevention/reduction significant heat transfer from one side of the insulation to another. The thermal requirements of interior textiles (especially in curtains, wall covering fabrics, floor coverings) are dictated by the ambient conditions. In cold weather, it is preferable to store heat inside the indoor area, while as ambient temperature increases, the requirements of heat storage decreases (19). Generally, textile fabrics possess thermal insulating properties depending on various factors (20) & (21):

- Still air contained (trapped) with the fabric and yarn e.g. texturizing (fabric structure).
- Bulk density of textile fabrics which indicates the sizes, number and distribution of spaces within the fabric.
- Fabric thickness (linear relationship between thermal insulation and fabric thickness).
- Weight of the fabric (linear relationship between thermal insulation and fabric weight).
- Fabric surface properties e.g. surface emissivity, smoothness.

3.2 Chemical Substances in Interior Textiles-Contaminants and Degradation Products

There is no house without consumption of interior textile products such as carpets, rugs, curtains, furnishings and decorative pillows which contain toxic substances that have deleterious impacts on air quality (1). These substances are carcinogenic, harmful to unborn child and to genetic material. The type of fiber and chemicals are factors influencing the release of substances from textile material. These chemicals are for example aryl amines derived from azo dyes, brominated flame retardants and dimethyl fumarate (3). Some examples of chemical substances released from textiles and may be of concern of human health and environment:

3.2.1 Aryl amines derived from certain azo pigments and dyestuffs

Approximately 60% of all disperse dyes (DDs) are azo dyes, and about 25% are anthraquinone dyes, the remainder distributed among quinophthalone, methine, naphthalimide, naphthoquinone and nitro dyes. DDs create almost the entire range of shades, are cheap and easy to apply. They are mostly used in polyester colorant and classified as allergenic (22). Azo dyes are widely used to treat textiles particularly cotton, leather and as well in printing inks, crayons, industrial paints, varnishes, plastics and other products. Aromatic amines associated with azo dyes have been classified as mutagenic, carcinogenic and highly toxic to reproduction (23).
(acid dyes, basic dyes, direct dyes, reactive dyes, fluorescent dyes, indigo dyes, sulphurous dyes, disperse dyes)

3.2.2 Formaldehyde released from certain reactive resins

Formaldehyde (HCHO) is used in textile finishing process to increase wrinkle and flame resistance, helps penetration of dyes and inks, and compatibility with other finishing agents such as emulsifier and whitening (24). It has some useful purposes with respect to textiles, but it is a toxic air contaminant released indoors from numerous consumer products such as permanent-press fabrics and fiberglass insulation (25). It's a potentially dangerous substance, personal exposures to HCHO indoors can cause skin irritation, respiratory problems, cough and burning sensations in the eyes, nose and throat (24).

3.2.3 Brominated flame retardants (PBDE) and Perfluoroalkylated compounds (PFAS)

Brominated flame retardants (PBDE) often used in textiles, computers and furniture foam. Frequent exposure to PBDEs can include impaired development of the brain and thyroid, fetal malformations, hearing deficits, delayed puberty and possibly cancer (26). The water-oil dirt repellent perfluoroalkylated compounds (PFAS) added to carpets and textiles, they are known by their toxicological and carcinogenic impacts in humans (27).

3.2.4 Polyaromatic hydrocarbons (PAHs) impurities in pyrolysed products, Carbon Black,

Polyaromatic hydrocarbons (PAHs) may be found in carbon black pigments/dyestuff, extender oils/softeners, lubricants, printing pastes, dye dispersing agents (Naphthalene), and in the manufacture of synthetic fibers (28). Home textiles are the major end-users for carbon black. It has also been used in military fabrics to comply with the color requirements and lessening of infrared radiation. It incorporated into the fabrics through three processing printing; dyeing; and in the fiber (29).

3.2.5 Thermal Toxic heavy metals due to impurities from the raw material, dyeing and printing operations of textiles:

Heavy metals are elements with metallic properties and an atomic number greater than 20 e.g. aresenic (As), lead (Pb), mercury (Hg), chromium (Cr), cadmium (Cd), zinc (Zn), cobalt (Co), nickel (Ni) and copper (Cu) (30). They are known for their hazardous properties which can lead to grave consequences in terms of human health and environmental balance, however, they are widely used for production of colour pigments of textile dyes (31). These metals can penetrate into fibers of textile during production, dyeing and printing operations or can exist in the structures of textile or through protective agents used during storage (32).

4 THE EFFECT OF INDOOR AIR POLLUTANTS, CAUSED BY FABRICS, ON HUMAN HEALTH

Some textiles used in the interior space cause indoor air pollution, especially ones which are treated chemically by hazardous compounds to acquire certain properties to the fabrics which negatively affects the indoor air quality either directly or indirectly. Hazardous chemicals can be released from interior textiles in several ways, when textile products are used and during laundering operations; and ultimately are disposed of as waste. Therefore, substances in textiles will be available for exposure of both humans and indoor environment. Release of chemical substances patterns include evaporation in the air, particulate releases can be in the form of indoor dust, leaching and migration. The uptake routes of these patterns are inhalation, saliva, skin etc. Particulate releases are during ordinary use and laundering; and consist of fiber fragments (3). Some substances bind very loosely to the material; consequently they will have high molecular releases during use and easily migrate to human body through air (breathing) or skin contact (touch textile products).

4.1 The Direct effect

Direct effect occurs when chemical substances volatile and spread in the indoor environment of buildings mixed with the air inhaled by human. They affect human health beginning with the skin, causing inflammation and skin diseases; as well as eye, nose and mouth through transferring of textile-related substances from surroundings. They also affect the respiratory system as these volatile substances cling to parts of respiratory system causing diseases start with asthma and end with cancer; consequently, the rest of human body is affected. Table-1

4.2 The Indirect effect

Indirect effect occurs as a result of the reaction of volatile chemical compounds with other contaminants present in the indoor air such as:

- Chemical compounds from the surrounding environment (outdoor area) leaked to the interior spaces.
- Biological contaminants that may be present as a result of some indoor activities or breeding pets.
- Leakage of dust and its pollutant contents to interior spaces.
- Interaction with various pollutants leaking from building substances, interior finishes and raw materials used in interior design, furniture and accessories.
- Interaction with human activities practiced indoor such as cooking, metabolic processes and some bad habits such as smoking.
- Use of products containing chemicals such as detergents, pesticides, perfumes and others.

4.3 Indoor Air Quality- Exposure to Hazardous Substances

Frequent use of textiles leads people to exposure to

hazardous chemical contents in textiles. Human exposure to hazardous chemicals may occur in several ways:

TABLE 1

A TABLE OF RELEASE OF HAZARDOUS SUBSTANCES FROM INTERIOR TEXTILES

Chemical Compounds	Treatment and Finishing	Types of Fabrics	Releasing and Causes	Diseases Caused	Possibility to Control
1- PET (Poly ethylene terephthalate). 2- Nanofibers (Nylon 6, polyacrylonitrile (PAN)). 3- Polyurethane (PU). 4- PVC (Poly vinyl chloride) 5- Aluminum Foil.	Acoustic Finishes	Natural/ Synthetic/ Blend PCBs (Poly Chlorinated Biphenyls) used in synthetic fibers (volatile/evaporate) depending on high humidity and temperature.	- (PET) Phthalates volatile/evaporate depending on high humidity and temperature.	- PET causes exacerbation of asthma and cellular changes that may lead to tumors. - PAN and PU cause adverse effects in the indoor air quality as well as on human health.	Enhance textile performance characteristics through parameters affecting sound absorption e.g. air flow resistance and resistivity, impedance, thickness, density...etc. to a level comparable to conventional acoustic materials e.g. polyurethane foams.
1- Flame retardants may contain: halogen, nitrogen, phosphorus, sulphur, boron, metals. 2- Toxic bromine derivatives (Brominated flame retardants PBDE).	Flame-Retardant Finishes		- Release formaldehyde (HCHO) during the fabric uses. - PBDE volatile/evapo rate at high temperature and high humidity.	- Formaldehyde cause cough, difficulty of breathing, burning sensations in the eyes, nose and throat, irritation of the skin. - PBDE cause impaired development of the brain and thyroid, fetal malformations, hearing deficits, delayed puberty, possibly cancer.	Using of Eco-friendly finishing agent to improve flame retardant properties e.g. TiO2 nanoparticles. (33) & (34)
1- Triclosan (2,4,4-hydrophenyl trichloro (II) ether). 2- Quaternary ammonium compounds (QACs). 3- Metallic salts e.g. copper, zinc, cobalt, and nickel.	Antimicrobial Finishes		- Dermal absorption during touching take place.	QACs are biocides and pose a risk to human health: Constrictions of the airways in asthmatic persons. An allergic response. Skin irritation. Copper constitute deterioration of human health if migrate through skin.	Using of eco-friendly substances and technology such as: - Chitosan and its modifies range analogs. Plasma Sputtering.
1- Aromatic compounds in dye/pigment e.g. Azo dyes. 2- Textiles auxiliaries e.g. - Catalysts. - Dye carriers. - Dispersing agents e.g. naphthalene 3- Polyaromatic hydrocarbons (PAHs) e.g. carbon black in pigments/dyestuf 4- Toxic heavy metals in production of colour pigments of dyes and from dyeing and printing operations. e.g. potassium dichromate as an oxidizing agent for Sulphur dyes. 5-Chromiun (Cr) and Copper (Cu) for colour textiles.	Colour Fastness Property	Natural/ Synthetic/ Blend PCBs (Poly Chlorinated Biphenyls) used in synthetic fibers (volatile/evaporate) depending on high humidity and temperature	- Azo dyes release toxic substances depending on high humidity and temperature affect human health through inhalation. - Dermal uptake of PAHs and Cu (through skin) when contact with textiles.	- Azo dyes classified as allergenic and mutagenic cause development of bladder cancer, splenic sarcomas, hepatocellular, carcinomas, cell anomalies. - Naphthalene cause breakdown of red blood cells. - PAHs and Cu causes eye irritation, vomiting and diarrhea. - Toxic heavy metals affect immune system, damage the nervous system, cause cancer.	Green chemistry in textile processing e.g. greener fiber, greener dyes and auxiliaries, bio-processing and elimination of hazardous chemicals. (35)

1- Perfluoroalkylated compounds (PFAS). 2- C8-Fluorocarbon based chemicals. 3- Paraffin wax combined with aluminum or zirconium salts.	Repellent Finishes (Oil, Soil and Durable water repellent)	Natural/ Synthetic/ Blend PCBs (Poly Chlorinated Biphenyls) used in synthetic fibers (volatile/evaporate) depending on high humidity and temperature	- Fluorochemical polymer volatile/evaporate depending on high humidity and temperature. - Fluorocarbon releases perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) which are hazardous materials.	- Fluorocarbon and Fluorochemical polymer cause developmental delays, tissue problems, some forms of cancer. - Perfluoroalkylated compounds (PFAS) have toxicological and carcinogenic impacts in humans. - Auminum and zirconium salts are harmful substances.	Search out alternatives of conventional (C8-based fluorocarbons) e.g. C6 and C4 based fluorocarbons which are free from toxic (PFOA) and ecologically optimised agent (36).
1- Polyethylene glycol (PEG) (melt PEG with polyethylene terephthalate). 2- PVC (Polyvinyl Chloride). 3- PU (Polyurethane) 4- PTFE (Polytetrafluoroethylene) 5- Aluminum Foil.	Thermal Insulation	Natural/ Synthetic/ Blend PCBs (Poly Chlorinated Biphenyls) used in synthetic fibers (volatile/evaporate) depending on high humidity	PVC and phthalates: Human exposure through inhalation of textile-released fibers in house dust, ingestion of contaminated materials exposed to house dust.	- PVC and phthalates severe health risks and indoor environment pollution cause respiratory problems, irritation in the eye, birth defects, chronic bronchitis, skin diseases, cancer, headache. - PTFE include toxic compounds, pose health hazards.	Enhance textile fabrics thermal insulating properties e.g. bulk density, fabric thickness, weight of the fabric, surface emissivity etc. to replace toxicological textile finishing/coating operations that cause health related problems and indoor environmental concern with time (37).

4.3.1 Direct Contact with the skin (Dermal exposure):
Interior textiles e.g. furnishings, floor coverings, pillows, curtains and upholstery, made of both natural and synthetic fabrics and are used in close contact with the skin. According to the study of (38) of trace elements in home textiles findings was home textiles made of polyester showed higher levels of antimony (Sb) than those made of cotton. Titanium (Ti) levels were also significantly higher in synthetic fiber items. In colour textiles levels of chromium (Cr) and copper (Cu) were especially relevant. Thus, dermal absorption of these trace elements during touching take place. These contaminants penetrate in the skin after a prolonged contact with textiles products. Dermal exposure depends on several factors include the quality and amount of elements used; and also physical-chemical properties of the element. The remaining substance impurities of the dye's formation present in the fabrics may constitute deterioration of the human health if migrate through human skin (39).

4.3.2 Oral Exposure:
Small children often put things in their mouths or sucking on fingers that have been in contact with dyed articles, this mouthing/sucking behaviour may lead to serious consequences as elements can migrate from the fabrics to saliva. Components of water solubility properties are more likely to migrate to the saliva and released if the textiles article is chewed on. Through daily use, textiles release fibers that end up in indoor dust. In some cases, dust is a major source of exposure for children as they are often stay close to the floor.

4.3.3 Inhalation exposure:
Volatile compounds contribute to poor indoor air quality as they are more likely to be released from textiles where the emission rate subsides over time. These chemicals can cause acute and chronic health effects. Volatile organic compounds (VOCs) are chemicals which are volatile/evaporate at room temperature or ordinary atmosphere e.g. Inhaled VOCs may cause such effects as exacerbation of asthma and cellular changes that may lead to tumors. Textiles surfaces have the ability to accumulate released fibers and dust; thus, humans can also inhale chemical substances that are associated with textile-released fibers from articles. Therefore, cleaning operation had to be easy and continuous. Cleaning agents themselves could be a source of airborne pollutants. Type of textiles article, temperature and humidity can be factors affect VOCs emission (40). The potential health risks associated with VOCs dependent on the concentration of VOCs in the air and the Duration of exposure.

4.4 The factors controlling the strength or weakness effect of the internal pollutants on human health:
Impact of pollutants in the indoor space on human differs according to several factors:

4.4.1 Factors related to the environmental features in which a building is constructed:
- Climatic nature: temperature, humidity and air movement.
- Urban environment features: proportion of green areas, size of surrounded buildings and their nature residential, industrial or commercial ...etc.
- Features of the indoor environment of an interior space: its height from the earth surface, building orientation, materials and treatments used in construction operations, available architectural openings, means of ventilation, devices used in the indoor area; in addition to the nature of interior finishes and other materials used in the interior decoration.
- Possibility to change indoor air and renew it (replacement

of contaminated air with fresh one) through devices, and number of times of renewed air during the day.

4.4.2 Factors related to the characteristics of the occupants in the interior space such as:

- Age: children and elderly are affected faster by any contaminants than young people.
- Gender: gender variation, body structure, physiological and psychological composition make men less affected by certain compounds than women, and vice versa depending on type of pollutants and mood. Women are being in the weakest status during pregnancy and childbirth which make them more susceptible to rapid effect of certain chemical substances.
- Health status: Patient is faster affected by pollutants than healthy persons. This effect varies depending on the type of disease as some diseases weaken the immune system, which increases the vulnerability of human to pollutants.
- Lifestyle: lifestyle of each individual affects on his/her health status, and thus the response to pollution and being vulnerable to disease. Exercise, maintain sleep hours, inhalation of fresh air at the beginning of the day and balance between working and rest hours; are all have strong impact on body strength so that it can hold out and face of interior pollutants.
- Bad habits: smoking, excessive eating of certain foods and drinks such as alcohol, excessive contact with some pets..etc. are all factors help to increase susceptibility to diseases as a result of exposure to indoor air pollutants.
- Genetics: genetics has an effect on human susceptibility to hazardous substances as some people are more susceptible to infection because they carry some genetic genes that affect their ability to tolerate some contaminants in the indoor air.
- Number of occupants: number of individuals within specific indoor area; affect the indoor air quality when compared by the total area of the interior space. The increase of occupants in a certain interior space. Consequently, increase the contaminants resulting from interior activities which in turn increase the accumulation of pollutants and difficulty of disposal.

4 Conclusion

The used Textiles in the interior space varied in purpose, which imposes specific treatments through using chemical compounds. These compounds can gain several properties to fabrics that may vary according to the place nature. Some of the textile-related substances are active and volatile during high temperature and humidity; and may differ in characteristics when dealing with another compound. There are also other factors concerning indoor human activity such as cooking, laundering, and friction, which may increase the release of toxic substances in the indoor air, which affects its quality and, in turn, affects the respiratory health. Indoor air is affected by chemicals released from textile articles that have already been treated. These compounds have various effects on human health due to continuous exposure where they cause many diseases to varying in intensity due to human physical and psychological characteristics. Many methods may be used to reduce human exposure to these toxic compounds. These methods vary according to substance type and its properties, besides the characteristics of the interior space. If textile-related chemicals used have potential health hazards and volatile readily, at the same time, the interior space has a lack of ventilation opportunities. Therefore the use of this type of fabric that releases chemicals must be forbidden. However, if the same kinds of fabrics are used in another interior space that has a high rate of ventilation and the time of staying is minimal, there is no objection to use the fabrics but taking into account the health status and age of individuals in that interior space and the kind of activity practiced inside.

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