

REVIEW ARTICLE

Assessment of Wet Wipes and their Environmental Significance – A Review Article

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ABSTRACT

Nowadays, wet wipes are highly common in the cosmetics market. Also called moist tissues. Its primary function is cleaning. It is a fantastic substitute for traveling with water, soap, and a towel. Wipes are currently a non-woven material with a rapidly rising market. The wipes have a tendency to retain liquid and gather to hold debris, dust, and other cleared particles. Preservatives, water, surfactants, buffers, fragrances, and nutritious components are all combined to make wet wipes. The major disadvantage of wet wipes they are made of synthetic fiber are non-biodegradables which lead to microplastic pollution and harsh impact on the human skin, so get ride off these situations wet wipes industry should have to use herbal finished and eco-friendly fibers to make wet wipes for day-to-day use. The present paper aims to throw a light on the assessment of the environmental significance of wet wipes.

1. INTRODUCTION

Wet wipes are daily use product for personal hygiene and are used millions of people globally. Wet wipes basically manufactured from hydroentangled wet laid non-wovens, mixed with water-based lotion, non-wovens as a precursor of wet wipes consist of man-made cellulose fibers, for example, viscose fibers (Extract from plants). Wet wipes market was approximately USD 4.45 billion in 2021 and now expected growth as per the market expert it will reach around USD 8.3 billion by 2030. The compound annual growth rate of wet wipes will remain roughly 10.1% between 2022 and 2030.^[1]

Wet wipes are small to medium in size, which is moisten with water, surfactant, and other ingredients. The wet wipes or tissue is an emerging trend and rapidly growing market in the non-wovens or non-woven fabric's materials. Fabric is made by mechanical, thermal, or chemically processed. Beyond simple definitions, these wonderful fabrics open up a world for a lot of innovative opportunities for every type of industries. On-oven fabrics have specific properties such

as stretch, softness, cushioning, strength, resilience, stretch, flame retardancy, bacterial barriers, washability, and sterility. Wet wipes are used for cleaning purposes such as personal hygiene and household cleaning; wet wipes also known as disposable wipe, baby wipe, wet towel, moist towelette, etc.^[2]

There are six types of wet wipes in the market:

1. Make-up removal wipes
2. Deodorant wipes
3. Flushable wet wipes
4. General cleaning wipes
5. Intimate wet wipes
6. Pet wipes
7. Disinfecting wet wipes.

In recent publications, some newsfeed critics raised the question that wet wipes are flushable. It contributes to sewer blockage, called fatberg, or can be found in sewer pump blockage. Biodegradable testing of wet wipes is usually done by *Slosh box test*.^[3]

1.2. History

American Arthur Julius 1st time thought in 1957 about wet wipes she has the idea to create wet nap (disposable wet napkin) she worked in the cosmetics industry.

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Julius trademarked her brand with the name Wet-Nap in 1958 that name still being used. Initially, wipes are simple and made by pulp or paper or rayon formed by dry laid and wet laid methodology after some time spun laced rayon/polyester wipes introduced.

In 1960, she unveiled her invention in National restaurant show in Chicago America, and started selling Wet-nap product's in 1963 to Colonel Harland Sanders they distributed to the customers of the Kentucky Fried Chicken.^[4]

1.3. Non-woven Fabric

Non-woven fabric is the material made by staple fiber (short) and long fiber (continuous long). In the textile industry, fabric which is made by traditional methods of weaving and knitting fiber's is known as non-woven fabric. It is used to create most of the household and medical goods.

Three types of non-woven fabric used in the industry:

1. Spun-lace non-woven (basically used in wet wipes, face sheet mask, etc.)
2. Spun-bond non-woven (used for things like carpet backing or filters.)
3. Melt-blown non-woven (used extensively in medical mask production, diaper, and feminine hygiene products.)

All three types of non-woven images are shown given below:

Non-woven fabric is used to make carry bags. We get it while we shopping for something from retail store. It is a best alternatives of poly bags and paper bags. Wipes consumptions were increased very high during COVID-19 pandemic globally.

There are two types of primary process used in the manufacturing of wet wipes non-woven fabrics are the wet laid and the dry laid process non-woven fabrics are the wet laid and the dry laid process non-woven fabrics are the wet laid and the dry laid process.

- a. Wet laid and
- b. Dry laid process.
- a. Wet laid applicable for soften cloths such as diaper wipes and cellulose blend. Fabric is basically can be made in wet suspension with water and other chemicals. Paste is pressed into the flat sheets by the help of the roller. Then further these rolls processed and slit into the narrow width then cut into the number of sheets. The finished cloths are classified by their dry weight that is around 1.4 oz/in² (40 g/m²) now absorbency of the wipe is also a parameter of good quality of wipes it can absorb 200% and 600 % lotion of the weight.^[5]
- b. Dry lay applicable to make non-woven fabrics from polymer resins. This process the melting plastic pellets and forcing them by tiny holes using air pressure. After that, fiber's cool down and condense, and hot roller flatten and bond them into the sheet.

A part from a fabric the cleansing ingredients used as water, surfactants, fragrance, moisturizer matter, and preservatives. The wipes universally hold all the liquid part or collect.

Fungal growth often observed in the wipes, it is very susceptible to fungal growth as compared to skincare and other cosmetic product.

Thus the formulation of wet wipes is very critical to make in the production. It needs more precautions and handling during its manufacturing process such as fabric chosen to time of finished packaging.

Other important concern about wet wipes is long time durability. All process depends the use of components common preservatives such as potassium sorbate, sodium benzoate, moisturizer, pH adjuster, antioxidant's, solubilizers, and main components are water. In general, two systems used in the wipe basic preservative system and composite solution system. Basic system used for human body, baby wipes used in hotel towel, etc. However, composite system used in the kitchen wipes, makeup removal wipes, industrial wipes, and pet wipes materials are cited in figs 1 to 7.

1.4. Quality Measures

Food Safety and Standards Authority of India: BIS is responsible authority of the implementation of any regulation in India and all activities will govern by the FOOD and DRUG COSMETIC ACT.^[6]

There are no specific BIS standards for wet wipes but basic requirement of quality standards for textiles and non-woven fabrics can applicable in the manufacturing process of wipes.

We have done the whole study of our wet wipes' formulation, production, packaging raw material testing, finished product testing, quality check, and stability study [Table 1 and 2].

2. MATERIALS AND METHODS

2.1. Material

Product wet wipes which are basically used as a make-up remover this wipe do not contain any preservative and does not have any chemical which may harm human skin as well. That is what makes this product different from others. These wet wipes are 100% viscous and imported from the natural source of wooden plant and 100% biodegradable as well. Whatever the ingredient we have used in the lotion inside the wet wipe that is highly pure in the purity and precision, we have two types of product at a glance one is preservative free and another with the added preservative as well.^[7] Common ingredients composition of the wet wipes are water (>99%), and the rest are silicon oils and herbal extract.

2.2. Methods

Fabric visualization (10×) by Microbiology technique

1. This wet face wipes go beyond makeup removal it also nourishes your skin with time-tested ingredients such as rose and milk.
2. Wet wipes remove makeup and refreshes your skin while maintaining the skin's natural balance.
3. It also removes stubborn makeup and impurities while leaving your skin refreshed and hydrated.^[8]
4. Made from renewable non-woven fabric.^[9]
5. Rose and Milk is a special blend prepared for dry skin. Rose is soothing and toning while being gentle on the skin. Milk proteins keep skin nourished, moisturized and supple for long hours.^[10]

3. DISCUSSION

Wet wipes becoming a necessity for daily use. Overhydration, the presence of make-up kit composition, and irritants from environment pollution particles which contribute to the skin irritation and unhygienic feeling. Wet wipes become one of the biggest substitute of removal of unwanted residue from the face and the baby skin for maintaining skin energy and smoothness using wet wipes that are free from potential irritants and contaminants and can support to maintain the acid mantle of the skin and can improve skin health. A significant advanced development in wet wipes is baby wipes used to clean baby skin. There are several clinical studies have shown the data of properly formulated wet wipes

can be superior rather than use of water and ordinary cloth. However yes, that is very important that we need to ensure during the formulation of baby wipes that ingredients used should have carefully selected by the business professional based on their safety profile. Ingredients should have free from any harm such as skin irritation, allergenicity, and itching. Precaution all industry experts should have made it practice only natural antibacterial ingredients, extract to be use. Moreover adhere to follow quality, regulatory guidelines established by recognized scientific organizations to ensure the wipes are not contaminated before or after use. Most importantly wipe industries should have think about naturally occurring resources to produce wet wipes fabric and need to made more awareness for sustainable wet wipes which are beneficial for the consumer and friendly for the environment.

4. CONCLUSION

Wet wipes have become one of the daily necessities for consumers. The spunlace non-woven fabric, whose main raw materials are petroleum-based fibers (mainly polyester fibers) and bio-based fibers (mainly viscose fibers), is the predominant component of wet wipes. The bio-based wet wipes outperform the petroleum-based ones in the lower resource consumption and toxicity risk, albeit it may induce water pollution. In the direct leakage scenario, bio-based wet wipes can avoid various risks of microplastic fibers disintegrated by polyester fibers. The main findings of this paper support the policy suggestions that bio-based wet wipes are proper alternatives for petroleum-based wet wipes, and it is essential to change consumers' discarding behaviors to attenuate the leakage risk of wet wipes.

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6. AUTHORS' CONTRIBUTIONS

All the authors contributed equally to the design and execution of the article.

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8. ETHICAL APPROVALS

This manuscript not requires ethical approval as it is a review study.

9. CONFLICTS OF INTEREST

Nil.

10. DATA AVAILABILITY

This is an original manuscript and all data are available for only review purposes from authors.

11. PUBLISHERS NOTE

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Table 1: Types of fabric used in wet wipes

S. No	Fabric type	Properties
1	Polyester	Good in strength, fineness and length, absorption
2	Polyethylene	Warm, soft, lightweight, flexible
3	Polyvinyl alcohol	Resistant to oils, solvents, and grease
4	Polypropylene	High heat deflection temperature (HDT)
5	Cotton	Good absorbent
6	Viscose	super soft, breathable, durable, and moisture-wicking
7	Mixed blends such as viscose, polyester, cotton, and lyocell fiber	Mixed properties

Product	Details of Fabric used in wet wipes 45GSM, Width-200 mm, Blend 100% Viscose	
S. No	Parameter	Units
1	(Grams per square meter) GSM	gm/m ²
2	Tensile strength (TS)	N/5cm
3	Molded Depth (MD)	-
4	Cross direction (CD)	-
5	Elongation (Grab tensile test)	%
6	Thickness	mm
7	Sinking Time	sec
8	Total Amount of Bacteria	CFU/g
9	Total Amount of Yeast Molds	CFU/g
10	Total Amount of Pathogens	CFU/g

Table 2: Some of commonly used Surfactants and Preservatives are given

Common surfactants used in wet wipes formulation			
S. No	Surfactant name	Conc % (limits)	Human dermal safety assessment
1	Cocobetaine (cocamidopropyl betaine) Amphoteric	<0.50%	Not a primary skin irritant or sensitizer even at high concentrations
2	Coco glucoside or Decyl glucoside or Lauryl glucoside (Non-ionic)	<0.50%	Not a primary skin irritant or sensitizer up to 5%
3	Glyceryl Sterate (Non-ionic)	1.0–2.0%	Safe in present practices of use and concentrations when formulated to be non-irritating
4	Bis-PEG/PPG-16/16 PEG/PPG-16/16 Dimethicone	0.10–0.45%	Not a primary skin irritant or sensitizer even at high concentrations
5	Glyceryl stearate citrate (Anionic)	0.50–2.0%	Little or no irritation or sensitization in multiple tests of dermal or ocular exposure
6	PEG-40 Hydrogenated Castor Oil (Non-ionic)	<0.80%	Little or no irritation or sensitization in multiple tests of dermal or ocular exposure
7	Polysorbate-20 (Non-ionic)	<0.50%	Safe in present practices of use and concentrations when formulated to be non-irritating
8	Sodium cocoamphoacetate or Disodium cocoamphodiactate	<0.50%	Safe in present practices of use and concentrations when formulated to be non-irritating

Common Preservatives used in wet wipes formulation			
Sr.No	Preservative Name	Conc % (limits)	Human dermal safety assessment
1	Phenoxyethanol	<1.0%	Neither a primary irritant nor sensitizer
2	Sodium Benzoate (Benzoic Acid)	<0.45%	Safe for use up to 0.5%
3	Dihydroacetic acid	<0.10%	Not irritating
4	Sodium Carylate	<1.0%	Not irritating
5	Benzalkonium chloride	<0.10%	Not irritating
6	Dehydroacetic acid	<1.0%	Not irritating
7	Potassium Sorbate (Sorbic Acid)	<0.50%	Not irritating or sensitizing up to 0.5%



Figure 1: Spun-lace non-woven



Figure 2: Spun-bond non-woven



Figure 3: Melt-blown non-woven

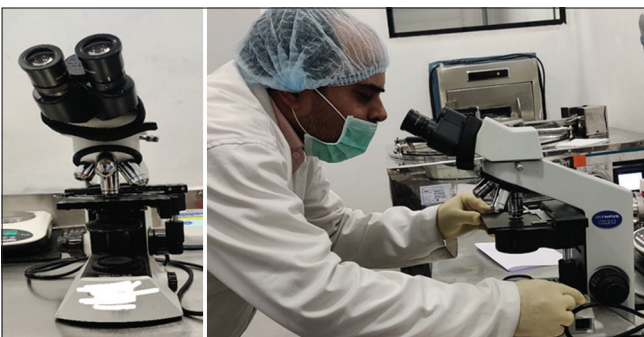


Figure 4: Visualizing fabric structure by Olympus CX21 microscope

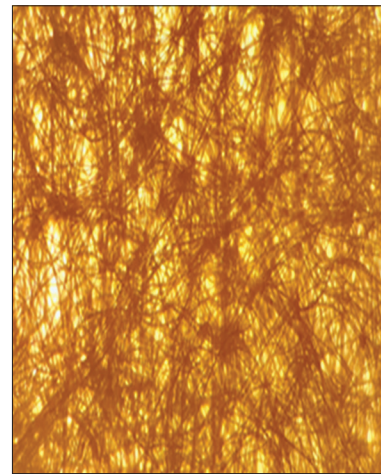


Figure 5: Polyester fabric

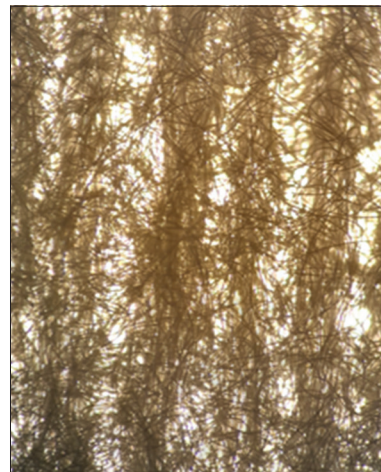


Figure 6: Viscose fabric

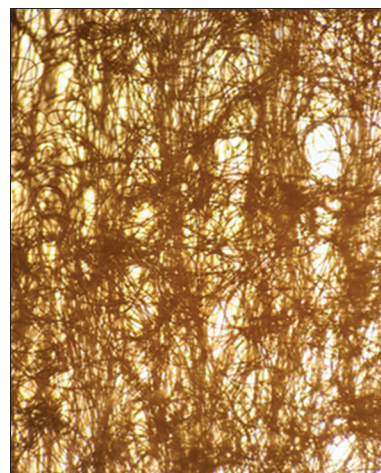


Figure 7: Polyester + Viscose Fab