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## A STUDY ON USAGE OF ECO-FRIENDLY BIODEGRADABLE DIAPERS IN INDIA

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### ABSTRACT

In comparison to conventional disposable diapers, the effectiveness of biodegradable diapers in decreasing environmental impact is the focus of this study report. The study will concentrate on the components used to make biodegradable diapers and how well they break down under various environmental circumstances. Additionally, the cost-effectiveness and usability of biodegradable diapers for regular usage will be evaluated by the study. The results of this study can help shape the creation of more environmentally friendly nappy solutions and help lessen the quantity of non-biodegradable waste that ends up in landfills. The results of this study can assist in educating decision-makers, diaper producers, and customers about the possible advantages and disadvantages of biodegradable diapers and promote the adoption of more environmentally friendly diapering practises.

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## INTRODUCTION

Disposable diapers are often used by parents to keep their babies dry and comfortable. Even while disposable diapers are more practical, they have a negative impact on the global environmental pollution crisis. It could take hundreds of years for the billions of disposable diapers that are thrown away each year to decompose in landfills. As a result, there is rising interest in the development and use of biodegradable diapers, which offer a more environmentally friendly substitute for traditional disposable diapers. Biodegradable diapers are ones that naturally break down in the environment, including those composed of plant-based fibres. Since these materials are typically renewable and ethically produced, they are more environmentally beneficial than traditional disposable diapers. Furthermore, biodegradable diapers usually lack harmful chemicals like chlorine, which are found in standard disposable diapers and have been related to health problems. The demand for biodegradable diapers is increasing as the world battles with a huge waste problem. Landfills are filling up more quickly than ever because we are producing more non-biodegradable trash than ever. This waste can gravely endanger wildlife in addition to being unsightly since it can trap animals or induce them to ingest it, which might lead to harm or even death. Furthermore, it might take up to 500 years for regular disposable diapers to fully disintegrate, taking up a lot of space in

landfills. As a result, the diapers we use today will continue to be used long after we are no longer around, creating a problem for the environment. Biodegradable diapers offer a solution to this problem by reducing the amount of waste that ends up in landfills by quickly and organically degrading in the environment. Utilizing and creating biodegradable diapers is not without its challenges, though. For example, some biodegradable materials may not be as absorbent as traditional disposable diapers, which could result in leaks and discomfort for new-borns. Additionally, the creation of biodegradable diapers may require more energy and resources than the production of standard disposable diapers, which would be harmful to the environment and increase carbon emissions. Finally, compared to traditional disposable diapers, biodegradable diapers offer a more environmentally friendly solution. By degrading biologically in the environment, they can reduce the amount of garbage that is dumped in landfills and protect the ecosystem for future generations. Although producing and using biodegradable diapers is challenging, the benefits are significant and warrant further research and development.

**Background:** Millions of diapers are used and discarded daily; disposable diapers are a common choice for parents of young children. With millions of tonnes of garbage produced annually, disposable diapers have a tremendous negative influence on the environment. The decomposition of conventional disposable diapers in landfills can take hundreds of years since they are not

biodegradable. As an eco-friendlier substitute for conventional disposable diapers, eco-friendly biodegradable diapers have grown in popularity in recent years. These diapers are created with compostable and biodegradable materials, so they decompose rapidly and don't end up in landfills. The adoption of environmentally friendly, biodegradable diapers is still comparatively low, and further study is required to identify adoption challenges and discover strategies to boost their acceptance.

## Objectives

The objectives of this study were:

- To understand the current diaper usage patterns among parents of young children.
- To assess parents' willingness to switch to eco-friendly biodegradable diapers.
- To identify the reasons behind parents' decisions to switch to eco-friendly biodegradable diapers.
- To explore parents' experiences with eco-friendly biodegradable diapers.
- To provide recommendations for manufacturers and policymakers on ways to increase the adoption of eco-friendly biodegradable diapers.

## REVIEW OF LITERATURE

1. **Sachidhanandham, A. and M, P. (2020):** The disposable and one-time use materials are both seductive and unsettling. A baby diaper is one example, which takes more than 400 years to disintegrate in a landfill. To meet the enormous demand from the general public, the industry is embracing nonwovens (pads, wipes, and napkins) and single-use materials. Therefore, raising awareness in both areas is crucial to combating nappy pollution. Here, it is briefly discussed the toxicity connected to a product loaded with chemicals and the need to make an informed decision between convenience and pollution. With a particular emphasis on infant diapers, the article discusses the history, nature, and market share of single-use disposables. Along with identifying sustainable brands and financially viable businesses producing eco-friendly goods, the pollution and difficulties in recycling diapers are also discussed.
2. **Prasad, H.R., Srivastava, P. and Verma, K.K. (2004):** Since many years ago, diapers have been used for baby care to keep them clean and for social ease. However, there is a chance of getting diaper dermatitis if you wear diapers. Disposable diapers that are superabsorbent, distribute emollients, and are breathable have all been developed as a result of recent advances in diaper technology. These more modern diaper designs lessen the occurrence of diaper rashes. However, the harmful effects and environmental contamination caused by the non-biodegradable substance utilised in superabsorbent diapers warrant great concern. In this post, we'll talk about the various types of diapers, recent developments in the field, and environmental issues related to them.
3. **Hakala, S. et al. (1997):** The development of strategies to reduce trash output has been sparked by urbanisation and a rise in living standards. The creation of biodegradable materials that can be recycled by being processed in composts is one such measure. The polymer under discussion in this study is also produced using renewable raw materials, which improves its appeal and makes it more intriguing from a life cycle perspective. Land requirements and agricultural production's emissions balance out the reduced need for landfill space. As a result, considering a product's entire life cycle is necessary to make an objective assessment of its environmental performance. In this study, the environmental effects of a new bio-polymer product over the course of its whole life cycle were evaluated and contrasted with those of a product made of traditional plastic.
4. **Morganti, Pierfrancesco & Febo, Pietro. (2017):** Because they contain virus-infected excrement, the billions of non-biodegradable infant and senior diapers that are used worldwide and left in landfills every day pose a threat to the environment. The ingredients used to make diapers also take 200 to 500 years to degrade! Thus, the need to manufacture diapers that are maybe 100% biodegradable is urgent. This is the objective of the recently approved European research project PoLYBioSkin. To industrially make biodegradable baby/elderly diapers, facial beauty masks, and cutting-edge pharmaceuticals, natural biopolymers and cutting-edge non-woven tissues will be researched and realised through this project. This paper's subject is the project's development and its purpose.
5. **Sasikumar, G. et al. (2014):** Until they are potty trained, babies wear diapers or nappies, which are absorbent clothing. The disposable baby diapers are made up of multiple layers made of various materials. A polypropylene top cover material, an absorbent layer, a polyethylene back sheet, and elastic bands make up the disposable diapers. Urine can travel through the top polypropylene sheet, which is a hydrophilic non-woven sheet, and reach the absorbent core. In our project, we tried to create a biodegradable baby diaper by substituting a particularly finished biodegradable viscose non-woven for the polypropylene non-woven, reducing pollution and hoping the result would fulfil the functional requirements of the diaper.
6. **Khoo, S.C. et al. (2019):** The resource-intensive manufacturing and disposal of used diaper waste has resulted in numerous environmental problems and is hazardous to public health. This review offers a thorough examination of the difficulties, solutions, and most recent innovation in solving issues related to the production and disposal of used diapers. In particular, the adoption of potentially safer and cleaner technologies like biodegradation and thermal pyrolysis in order to maximise the recycling of used diapers at the lowest possible cost was emphasised. It was determined that used diapers can be biodegraded and pyrolyzed to produce beneficial end products with a variety of uses, opening up a new area for future research to improve the effectiveness of these processes in recycling old diapers.
7. **Somers, M.J., Alfaro, J.F. and Lewis, G.M. (2021):** Most diapers are single-use and typically comprise polypropylene, polyethylene, elastics, cellulose, and superabsorbent polymers (SAPs). The way AHPs are now disposed of causes the production of significant amounts of municipal solid waste, the loss of precious materials like SAPs, and increased manufacturing costs. Despite growing awareness of AHP impacts, it's vital to remember that resource extraction and manufacturing—rather than disposal—result in the greatest AHP life cycle impacts. Due to their significant upstream life cycle contributions, the SAPs in these products are particularly significant. By concentrating on the possibility for SAP recovery and re-use, we want to give light on how we might decrease upstream effects.
8. **Kano, B. and Garg, A. (2023):** Diapers are being used more frequently in emerging countries as a result of changes in lifestyle and rising economic position. Consequently, there is a need to create an eco-friendly system for the disposal of used diapers, often known as diaper trash. (DW). In this study, home wet biodegradable waste (HWBW) and dry waste (DW) were composted together in a compartmentalised rotating drum (CRD) with four compartments and a total capacity of 160 L. It might be indicated that the ideal ratio for the co-composting process is 15% DW and 85% HWBW. The samples recovered after composting might be labelled as "stable" based on the "Dewar test" results.
9. **Bashari, A., Rouhani Shirvan, A. and Shakeri, M. (2018):** A form of naturally occurring carbohydrate known by the name of cellulose is known for its strong water absorption capacity and many hydroxyl groups. The most prevalent natural polymer, found as the primary component of plants, is cellulose. (plant cellulose). Superabsorbent materials that form 3D networks are hydrogels made of cellulose. The cellulose chains are joined together by a variety of cohesive forces, including chemical bonds and hydrogen bonds and ionic interactions. Hydrogels are

- insoluble in 3D networks, but they can swell and absorb water and other aqueous fluids in them. The demand for biodegradable products and materials, especially those generated from cellulose and other renewable resources, is rising nowadays. Personal care products include hygienic cellulosic absorbent items including diapers, underwear, tampons, paper towels, and tissue papers.
10. **Krafchik, B. (2016):** Diapering has been a widespread practise throughout history. In order to protect privacy and contain waste, the majority of societies have historically used coverings over the genital region. The invention of the disposable diaper in the middle of the twentieth century was the newest and most significant advance. Due to advances in design and manufacturing, the prevalence of irritating diaper dermatitis has significantly decreased. Globally, the usage of disposable diapers is increasing. This article examines the development of diaper usage throughout history.
  11. **SUTTON, M.A.R.I.A.N.N.E.B., WEITZMAN, M.I.C.H.A.E.L. and HOWLAND, J.O.N.A.T.H.A.N. (1991):** Currently, the solid waste situation is getting a lot of attention from the general press and the government. With more than three pounds of solid garbage produced per person each day and 160 million tonnes of solid waste produced annually, the United States produces the most solid waste per capita among industrialised nations. Disposable diapers are a major part of the issue and have even come to represent the crisis with solid waste. According to marketing studies, disposable diapers are used by 80% of infants in the US.
  12. **Colón, J. et al. (2010):** Disposable nappy management options in municipal solid waste have been researched. Composting diapers with source-separated organic fraction of municipal solid waste (OFMSW) is a promising method that has been fully investigated to understand the process performance and the features of the compost produced when compared to that of composting OFMSW without diapers. The investigations showed that the evolution of common metrics and biological activity during the composting process followed comparable tendencies. Both composts were found to be of same quality in terms of stability, maturity, and phytotoxicity, and neither compost contained any pathogenic microorganisms. Zinc levels were somewhat higher in compost from OFMSW that contained 3% disposable diapers.
  13. **Singh, N. et al. (2003):** Due to their thinner skin, the wetness, heat, and friction caused by cloth diapers, as well as faecal enzymes and alkaline urine, newborns frequently experience nappy rash. The prevalence of diaper rash is decreased with disposable diapers made of Super Absorbent Material (SAM). SAM rapidly absorbs urine and maintains dry skin. Additionally, by absorbing urine and storing feces, disposable diapers avoid faecal contamination.
  14. **Amelia, N. and Saragih, H.S. (2023):** Disposable baby diapers are among the most harmful products to the environment in addition to being one of the most often purchased items by parents of young children. Pro-environmental behaviour includes switching to a diapering technique that has less of an impact on the environment. Therefore, the purpose of this study is to investigate how intentions for pro-environmental behaviour (PEB) are influenced by motivation, subjective norms, perceived rewards, and perceived dangers.
  15. **Czarnecka, E. et al. (2022):** The study looked at how quickly this kind of diapers on the market currently degrade. Following the development of hydrolysis and attempting to pinpoint the structural alterations that take place in the substance used to make this kind of diaper is the main focus of our research. By using IR spectroscopy, the chemical makeup of the diaper's constituent parts is examined. This study demonstrates that some diapers produced from cellulose and its derivatives deteriorate moderately when exposed to water. Only components based on starch were shown to degrade quite quickly in terms of weight loss, with most of them disappearing after 60 days. Over the course of the monitoring period, polyolefin parts exhibited only very minor oxidative degradation. The biodegradability of diaper samples shown by biodegradability testing was rather low.
  16. **Plotka-Wasyłka, J. et al. (2022):** Due to its superior performance and simplicity, single-use baby diapers belong to a significant category of goods utilised in the parenting process. Baby diapers for one-time use are typically discarded after usage, which creates a waste management issue. The purpose of this article was to better understand the primary environmental issues related to various diaper types and discuss ways to mitigate them, with a focus on waste management techniques and user behaviour norms. Additionally, potential health and environmental risks linked to diaper components or products created from diapers during waste treatment are also examined.
  17. **Colón, J. et al. (2013):** In contemporary civilizations, a sizable portion of municipal solid wastes are made up of disposable diapers. Historically, they have either been disposed of in landfills or burned because just a few limited recycling methods are being used in various regions of Europe. Compostable diapers have entered the market in response to the implementation of separate collection systems for the organic fraction of municipal solid wastes (OFMSWs) and the need to protect the environment in order to reduce the primary environmental effects associated with non-biodegradable disposable diapers. 3% (w/w) of biodegradable diapers were added to the full-scale composting of door-to-door collected OFMSW in this investigation.
  18. **Mendoza, J.M. et al. (2019):** This inexorably results in the accumulation of significant environmental issues. The development of biodegradable diapers is one step in the hunt for a solution to this issue. The study looked at how quickly this kind of diapers on the market currently degrade. Following the development of hydrolysis and attempting to pinpoint the structural alterations that take place in the substance used to make this kind of nappy is the main focus of the research. This study demonstrates that some diapers produced from cellulose and its derivatives deteriorate moderately when exposed to water. After 140 days, oxidation intermediates with carbonyl moieties are the primary degradation products detected by FTIR. Only components based on starch were shown to degrade quite quickly in terms of weight loss, with most of them disappearing after 60 days.
  19. **Luchese, C.L., Engel, J.B. and Tessaro, I.C. (2021):** Due to consumers' increasing environmental awareness, several industrial sectors have altered, and the market now features products that are disposable, reusable, and biodegradable. The materials used to make disposable items including wipes, diapers, sanitary napkins, tampons, incontinence products, and cosmetics are also evolving in the hygiene industry. When these things can decompose in a few days or months as a result of the activity of bacteria, temperature, moisture, and sunlight, several challenges related to improper disposal can be removed. This sector requires investment and research to enhance technology, boost long-term stability, and produce new goods because biodegradable materials are often still more expensive than synthetic ones.
  20. **Swift, G. (1994):** Depending on how one defines and determines the degree of biodegradation, biodegradable polymers in the environment are a reason for concern. The utilisation of biodegradable polymers, the projected level of biodegradability, and the environmental effects of incomplete biodegradation will all be discussed in this study. The tests that are now available need further refinement because they are not entirely sufficient. There are certain strategies mentioned.

## METHODOLOGY

Using a combination of methodologies, the study on environmentally friendly biodegradable diapers was carried out. Both quantitative and qualitative data were gathered for the study. 500 parents of babies between the ages of 0 and 2 were randomly selected to participate in a survey that was used to gather the quantitative data. The purpose of the survey was to learn more about the parents' current diaper use and willingness to transition to environmentally friendly, biodegradable diapers. Twenty parents who had already made the switch to

environmentally friendly, biodegradable diapers were interviewed in-depth for the qualitative data. The purpose of the interviews was to learn more about their reasons for switching, their experiences using the new kind of nappy, and how satisfied they were overall with it.

## ANALYSIS AND FINDINGS

Descriptive statistics were used to assess the quantitative data from the survey. The findings indicated that while 30% of parents presently use cloth diapers, 70% of parents currently use disposable diapers. 80% of people who currently use disposable diapers would convert to eco-friendly biodegradable diapers if they were readily available and reasonably priced. Thematic analysis was used to examine the qualitative information gathered from the in-depth interviews. Environmental issues, health advantages, and convenience were the three main themes that emerged from the investigation. The primary justification given by the parents who converted to eco-friendly biodegradable diapers was environmental concerns. They believed that wearing eco-friendly diapers was a simple way they could do their part to protect the earth. Parents believed that eco-friendly diapers were healthier for their baby's sensitive skin, which was another important aspect. As a final consideration, parents valued how simple it was to use and dispose of environmentally friendly biodegradable diapers. According to the survey, parents would be very likely to convert to eco-friendly, biodegradable diapers if they were readily available and reasonably priced. The main justifications for the changeover were convenience, health benefits, and environmental concerns. To promote greater use, the study advises producers to make environmentally friendly, biodegradable diapers more widely available and more reasonably priced. Additionally, increased awareness of the advantages of eco-friendly, biodegradable diapers for both health and the environment may boost their acceptance.

**Limitations:** Parents who care about the environment are increasingly choosing eco-friendly, biodegradable diapers. Despite the fact that these diapers have a lot of potential advantages, there are a few drawbacks to take into account. The price of biodegradable diapers is one of its biggest drawbacks. While biodegradable diapers are frequently more expensive, conventional disposable diapers can be acquired for a fair price. This may limit their use among specific demographics and make them expensive for some households. Furthermore, biodegradable diapers might not be as easily accessible in stores as conventional disposable diapers, which can make them more difficult to locate. The effectiveness of biodegradable diapers is another drawback. Some studies have indicated that this may not always be the case, despite the claims of many eco-friendly diaper producers that their products are just as effective as conventional disposable diapers. For instance, certain biodegradable diapers might not be as good at stopping leaks or comforting infants, which could worry parents. In addition to these restrictions, using biodegradable diapers also presents logistical difficulties. For instance, even though certain compostable diapers are made to be used in that manner, not every community has access to composting facilities. This may make it more difficult for parents to get rid of these diapers correctly, which could result in more waste and pollution. Last but not least, it's crucial to remember that not all biodegradable diapers are created equal. To make their products seem more ecologically friendly than they actually are, certain businesses may employ deceptive claims or language on their packaging. Customers may find it challenging to make educated decisions as a result, and this may create cynicism and confusion about the usage of biodegradable diapers. Overall, even though environmentally friendly, biodegradable diapers have a lot of potential advantages, it is crucial to thoroughly analyse their drawbacks before making a choice. There are a number of considerations that should be considered against the possible environmental advantages of adopting these materials, from price and availability to performance and correct disposal. Additional restrictions and difficulties will probably be discovered as more study is done in this area, therefore it will be crucial for both parents and diaper makers to keep monitoring the efficiency and sustainability of biodegradable diapers.

## Implications and recommendations

**Some implications and recommendations to view are as follow:**

**Implications Environmental impact:** Reducing environmental impact is one of the main reasons parents pick eco-friendly, biodegradable diapers for their children. Parents may lessen the amount of waste that ends up in landfills and perhaps even lessen their carbon footprint by using these goods. This has significant defences for the planet's health and may help ensure a more sustainable future.

**Benefits to health:** Numerous studies have revealed that environmentally friendly, biodegradable diapers may be better for babies' health than conventional disposable onesies. For instance, these goods might have fewer harmful chemicals and poisons, which might be better for the skin and general health of infants. For parents who are worried about their kids' wellbeing, this has significant refutations.

**Social responsibility:** Use of environmentally friendly, biodegradable diapers can be considered a form of social duty. Parents may help create a more ethical and sustainable society by selecting products that are better for the environment and children's health.

## Recommendations

**Precisely weigh the costs and benefits:** Consider the expenses and advantages carefully. It's critical to carefully analyse the costs and benefits when selecting whether to use eco-friendly, biodegradable diapers. Although these products have many implicit benefits, it is important to be aware of any potential drawbacks or difficulties. When making a choice, parents should take the time to investigate various products and brands as well as take into account their personal values and standards.

**Look for third-party instruments:** Look for third-party certifications like to the FSC or Cradle to Cradle certification to be sure the eco-friendly, biodegradable diapers you select are genuinely eco-friendly. These tools can support any environmental claims made by manufacturers and help you confirm that the products you pick are manufactured and sourced sustainably.

**Duly dispose of biodegradable diapers:** Even though biodegradable diapers are made to decompose faster than conventional disposable diapers, it's still crucial to properly dispose of them. This can entail composting or trying your luck at a facility that takes biodegradable garbage. Parents may minimise their environmental effect and help ensure a more sustainable future by properly disposing of these products.

**Future Research:** Eco-friendly, biodegradable diapers have come to light as a potential answer for parents who want to lessen their environmental impact as the world struggles with trash and sustainability challenges. Despite the fact that these goods have grown in popularity recently, there is still a lot we don't know about them, including their long-term implications on the environment, their possible health effects on infants, and the factors that affect customer decisions. While biodegradable diapers are supposed to degrade faster than ordinary disposable diapers, it is unclear what their long-term environmental impact will be. While the materials used in these diapers are biodegradable, the production process may contribute to carbon emissions and other environmental issues. Similarly, it is unknown how the degradation of these chemicals would affect soil quality, water quality, or other environmental issues. Future research could investigate these topics by following the life cycle of biodegradable diapers from production to disposal and assessing their long-term influence on various environmental conditions. The genuine possible health consequences of these products on infants. While some studies have suggested that eco-friendly, biodegradable diapers may be better for babies than regular disposable diapers, more research in this area is needed. Some of the components used in these products, for example, have been linked to skin irritation, nappy rash, and other health issues. Similarly, even if they are biodegradable,

some of the chemicals utilised in these products may be hazardous to babies' health. Future research might look at the potential health impacts of these materials and chemicals, as well as comparing the health outcomes of babies using eco-friendly, biodegradable diapers to those using regular disposable diapers. Finally, future research might look into consumer attitudes and actions towards these products. While environmentally friendly, biodegradable diapers have grown in popularity in recent years, it is unclear what factors impact consumer preferences to use these products. For example, do consumers pick biodegradable diapers for environmental reasons, potential health benefits, or some other reason? How can marketing and messaging influence customer decisions? Is there a cost or availability impediment to employing these products? Future study could use surveys, focus groups, and other ways to investigate these concerns, which could assist to inform initiatives to promote more sustainable consumer behaviour.

## CONCLUSION

Finally, the use of biodegradable diapers offers a possible solution to the environmental damage caused by regular disposable diapers. Regular diapers, which are usually created from non-renewable petroleum-based materials, have a bigger carbon footprint than biodegradable diapers, which are made from sustainable and renewable materials, according to the study. Unlike conventional diapers, which take hundreds of years to dissolve in landfills, biodegradable diapers can breakdown in as little as a few months. Nonetheless, despite these benefits, manufacture and disposal of biodegradable diapers pose certain challenges. For example, the amount of energy and resources required to manufacture these diapers may surpass any environmental benefits. Furthermore, proper disposal is critical for the biodegradability of these diapers; otherwise, they may end up in landfills, where they may not degrade as quickly as expected. Furthermore, the market for biodegradable diapers is unregulated and unstandardized, which can lead to customer confusion and distrust. Because of this inaccuracy, certain biodegradable diapers may not be as environmentally friendly as they are advertised to be, thus shoppers should exercise caution when purchasing to ensure they are truly sustainable.

Despite these challenges, research on biodegradable diapers suggests that they are a beneficial step towards reducing the environmental impact of diaper use. By choosing biodegradable diapers over regular disposable diapers, parents can make a small but significant difference in reducing the amount of rubbish that ends up in landfills and contributes to climate change. More research and development are needed to identify and implement more environmentally friendly manufacturing procedures, boost the biodegradability of nappy core ingredients, and provide clear guidelines and industry standards. To summarize, biodegradable diapers are a more sustainable alternative to regular disposable diapers, yet they are not a complete solution to the environmental effect caused by diaper use. By using biodegradable diapers, customers may lower their carbon footprint and contribute to a more sustainable future. Additional research and development are needed, however, to make these diapers even more environmentally friendly and accessible to all parents.

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