ANALYZING ABSORPTION RATE OF DISPOSABLE BABY DIAPERS OF DIFFERENT BRANDS

BY

KIBALATSI FRED

(BU/UP/2023/1688)

A RESEARCH REPORT SUBMITTED TO THE DEPARTMENT OF PHYSICS IN PARTIAL FULFILLIMENT OF THE REQUIREMENT LEADING TO THE

AWARD OF THE DEGREE OF BACHELOR OF SCIENCE

EDUCATION OF BUSITEMA UNIVERSITY

APIRIL, 2026

DECLARATION

I **KIBALATSI FRED** declare that this research report entitled Analyzing Absorption Rate of Disposable Baby Diapers of different Brands is my original work and has never been submitted to any institution of higher learning for any academic award.

Signature: ..... **Date**: 26/05/2026

APPROVAL

This is to certify that this research report entitled Analyzing Absorption Rate of Disposable Baby Diapers of different Brands by Kibalatsi Fred was done under my supervision and is now ready for submission to the Board of Examination and Senate of Busitema University with my approval.

Supervisor.

Signature: ..... **Date:** 26TH-05-2026

Joseph Anthony Owalu
Lecturer,
Department of physics
Faculty of Science
Busitema University.

DEDICATION

This report is dedicated to my beloved family for their great love and support in my studies.

ACKNOWLEDGEMENT

I am grateful to the Almighty God for His favor, wisdom, good health, guidance and assistance, which enabled me to successfully complete the Bachelor of Science with Education program at Busitema University

Special thanks to my supervisor, Mr. Owalu Anthony Joseph, for his tireless efforts, guidance and advice offered to me during this period, you did much more than I could think of. I take this opportunity to thank all the different Heads and Lecturers in the Department of Physics Busitema University.

My sincere gratitude is also forwarded to the Physics Laboratory Technicians (chief Technician Edward and Mr. Gonzaga) Busitema university for their technical support and assistance.

I also thank all my friends of physics class 2023/2026, for the journey we have shared together. Special appreciation to mambo Cedrick, nadelega ambrose, kajubi paul micheal, watulo Jackson, wesoga emma, chemutai obed, munabya Dixon, wenya esther, cherotich lilian, nadala daphine, nuwamanya Daniel, ogaro shafik, etc for the friendship, teamwork, support and memorable moments.

To my brothers Bumbo Sam, Namonyo Davies and my sisters Kakayi Alice, Butoto Gloria, Kisaka Joan, kibukuna patience, kakayi alice Namakanda mercy and my beloved one Lunyolo Sharon, thank you for your love, support, and standing with me through every season of life. Your encouragement, care, and presence mean more than words can express. I'm truly grateful to have you in my life. Wishing you endless blessings and success always.

The author and publishers of different journals, newspapers who made their work available for research. Your work was fundamental during the course of this training and your work gave me a reason to finish this report.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Disposable baby diapers are complex products consisting of multiple layers of materials, most of which are not in direct contact with the skin.

Disposable baby diapers are widely used in many parts of developed and developing countries. It is estimated that 90% to 95% of diapers used are disposable. Today's disposable baby diapers are of high performance and well evaluated products purposefully designed to keep baby's skin dry. This is possible due to variety of specialized polymer materials including cellulose, polypropylene, polyester and polyethylene arranged in different layers that are used to provide optimal absorption of urine thereby minimizing skin exposure.

However, superabsorbent polymer differs in different brands, so a diaper absorption assessment is recommended to judge its quality. For that reason, five brands of diapers that is soft care,

cucttic, pampers, Mami love and baby love were taken to physics laboratory to analyze their liquid absorption. Each brand was tested in triplicate to ensure reliability. The methodology allowed for comprehensive comparison of absorption rates among the brands and by comparative study, the average absorption rate was in the range of 1100 wt% to 1593 wt% in saline solution. In my study, pamper brand had the highest absorption rate of 1593 wt% while baby love had the lowest absorption rate of 1100 wt% which is lower than the recommended value of absorption rate according to (Bachra et al., 2020).

I therefore, recommend that further research should be conducted on the scope of analyzing the absorption rate of disposable baby diapers of different brands.

CHAPTER ONE: INTRODUCTION

1.0 Introduction

This research is intended to analyze the absorption rate of disposable baby diapers of different brands. This section here describes the background, problem statement, purpose of the study, specific objectives, the scope and significancy of the study

1.1 Background of the study

Disposable baby diapers are type of diapers designed to be used at once and then discarded (Ntekpe et al., 2020). It contrasts with the cloth diaper that are reused by soaking, washing, and folding (Kamat & Malkani, 2003). However, disposable baby diaper preferred option because of high performance and convenience (Khoo et al., 2019). Thus, indispensable especially for working parents, therefore disposable baby diaper are also known as single use diapers (Cordella et al., 2015).

However, there are other types of diapers in the market namely cloth diaper are made from cotton which provides soft padding to avoid rashes on users skin as well as makes the diaper less hard and give it a specific shape , Biodegradable diapers general have super absorbent polymer Since the introduction of disposable baby diapers in the early 1960s, it has become an integral part of the economy that gradually expands the baby diaper industry (Tsigkou et al., 2020), Therefore, disposable baby diaper are far the most widely used diaper occupying around 95% of the world market (Zissis, G., Bertoldi, P., Serrenho, 2018) (SAP) with high water absorption properties for comfort and are more eco and skin friendly as it uses natural materials and fewer chemical to fabricate part of its components and Hybrid diaper product by combining cloth and disposable diaper material which are less harmful to the environment beginning from the year 2009.

According to report of International global baby production research, the global market for diapers exhibit arising trend (Oliver, 2024). According to (Ran, 2018), Europe dominates the market followed by the Asia Pacific and North America which contributes to more than USD 54 billion in 2016 and is expected to exceed 71 USD billion by 2022 (Płotka-Wasylka et al., 2022).

The top five producing countries are China, the United States, Japan, Germany and France. Other notable producing countries include Italy, south Korea and Taiwan. These companies such as

Procter and Gamble (Pampers), Kimberly Clark (Huggies), Unicharm (mamy poko), SCA (Liberio) and Kao (Merries), Hayat Kimya (Molfix) and so on are major multinational companies that dominates the global diapers market.

According to National Bureau of Statistics (The Uganda National Household Survey (UNHS) 2023/2024) indicates that there are several brands of disposable baby diapers available on the market in Uganda, but the country and other developing countries such as Kenya, Burundi, Tanzania, Zambia, Rwanda and so on heavily relies on imports from neighboring countries and international markets to meet the demands for disposable baby diapers. According to National Bureau of Statistics, Uganda imported over 1.3 billion units of diapers in 2020 valued at approximately USD 15 million. The market for disposable baby diaper in Uganda and other developing countries are dominated by international brands including pampers, Huggies, Cucttic, Walmart, and soft care, Up and UP diaper and so on.

Due to increased use of disposable baby diapers in healthy babies as well as children prone. Several reports show that disposable baby diaper of well-known brands may contain a number of toxic compounds for example xylene, toluene, ethylene benzene which may be risky for children's health leading to skin irritation. Also issues connected to disposable baby diapers has enormous impact on the environment (Płotka-Wasylka et al., 2022). Despite these challenges, disposable baby diapers remain popular choice for parents due to their ease of use and availability.

1.2 Statement of the Problem

Traditionally, parents used nappies to make babies comfortable and dry after urinating (Al-Sagarat & Al-Kharabsheh, 2017). However, nappies had a poor absorption rate because it was consisting of an outer waterproof layer that keeps the baby's skin in contact with urine for longer time thus resulting into skin rashes. Due to advancement in material science and modern technologies, many companies have come up with different brands of disposable baby diapers such as cuties diapers, soft care, pampers, Huggies diapers, Molfix diapers to provide comfort and prevents leakages. However, the absorption rate of these diapers is not known. Some of them are known to cause skin rush to infants one due to poor absorption rate (Prasad et al). The study therefore aims to analyze the absorption rate of different brands of baby diapers sold in Uganda.

1.3 Purpose of the Study

To analyze the absorptive rate of disposable baby diapers of different brands.

1.4 Specific Objectives

1. To prepare saline solution used to test absorption rate of disposable baby diapers.
2. To analyze the absorptive rate of disposable baby diapers of different brands.
3. To compare the absorption rate of disposable baby diapers of different brands.

1.5 Significance of the Study

This study is significant as it contributes to achieving two Sustainable Development Goals (SDGs). For example, Good Health and wellbeing which is SDG number 3 and Responsible consumption and Production which is SDG number 12. By evaluating the absorption rate of disposable baby diaper brands, the study promotes Good Health and wellbeing by identifying the most effective product that reduce the risk of skin irritation, urinary tract infections, and other Health issues. This ensures Health lives and wellbeing of infants and young children. Additionally, the study supports Responsible consumption and Production by providing evidence based information on disposable baby diaper quality ,enabling parents and caregiver to make well informed decisions ,reducing wastes and promoting sustainable consumption pattern ,ultimately contributing to a more environmentally friendly and responsible production of disposable baby diapers (Mendoza, Popa, et al., 2019) .

1.6 Scope of the Study

The study looked at analyzing the absorption rate of disposable baby diapers of different brands. In doing so, the disposable baby diaper samples such as soft care, cucttic, pamper, Mami love, and baby love which was used was collected from local market located in lwakhakha along mbale lwakhakha highway and these samples were of sizes two each brand. All laboratory experiments were conducted in Namisindwa Secondary School, Physics Laboratory.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter presents a review of related literature on the absorption rate of disposable baby diapers, their material composition, structural design, and the effects on infant's skin health. The chapter also examines comparative performance among different diaper brands and identifies methodological gap in existing studies.

Existing studies indicate that diaper performance largely depends on the use of superabsorbent polymers (SAPS) and the arrangement of internal layers. However, there are notable gaps due to limited comparative studies, lack of standardized testing methods, and minimal considerations of real-world usage conditions. Therefore, this review synthesizes available research, highlights inconsistencies, and provides a foundation for the current study.

2.1 Absorption rate of disposable baby diapers

The literature was focused on absorption rate of disposable baby diapers, how it is analyzed for the different brands and how it affects baby's skin. Extensive research has been conducted on disposable baby diapers focusing on the materials, designs and performance. Studies have investigated the impact of material composition on diaper absorbency revealing significant differences in absorption rates (Castrillon et al., 2019).For instance , diapers containing superabsorbent polymers demonstrated enhanced absorption capabilities compared to those without . Generally, disposable baby diaper is based on the specific objective of the study.

Comparative studies on diaper performance are scarce but existing research highlights significant variation in absorption rate among different brands. A study by Johnson et al. (2018) compared absorption rates of three (3) popular diaper brands, finding that B and A outperformed brands D and C. Similarly, Patel et al.,(2020) evaluates absorption capacities of five (5) diaper brands, concluding that brands D and E exhibited superior performance. These findings underscore the need for comprehensive comparative analyses to inform consumers purchasing decision.

Methodological limitation has been identified in existing studies, particularly regarding testing protocols. Standardized testing method for diaper absorbency are lacking leading to inconsistencies in reported results (Bachra et al., 2020). Furthermore, most studies have focused on laboratory testing neglecting real- world usage scenarios therefore to address these gaps, this

study aim to conduct comprehensive analysis of the absorption rate of disposable baby diapers from various brands employing a standardized testing protocol and considering real world factors.

Therefore, this study aims to analyze the absorption rate of disposable baby diapers of different brands using a simple experimental method.

2.2 Disposable baby diapers

Disposable baby diapers are also known as single use diapers, throw away diapers. Disposable baby diapers have revolutionized childcare convenience and hygiene, but absorption rate varies significantly among brands. Research show top performers utilize superabsorbent polymers and optimized core designs (Mendoza, D'Aponte, et al., 2019).

Nota Bene (NB) Superabsorbent polymers (SAPs) are materials that can absorb and retain large amount of water and aqueous solutions. And is a synthetic material derived from petroleum, manufactured primarily as granular sodium polyacrylate, produced by the polymerization of acrylic acid with ammonium persulfate as initiate which can absorb and retain large amount of liquids.

The disposable baby diaper is shown in the Figure 2.1.

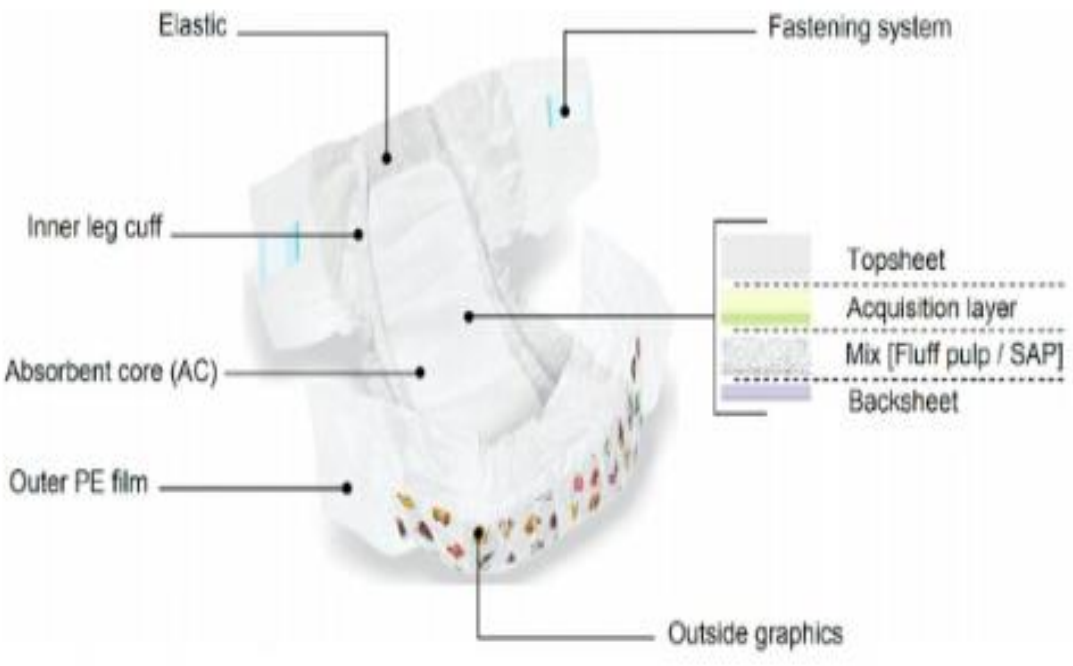

Figure 2.1: Schematic representation of disposable baby diapers (Dey et al., 2016).

2.3 Functions of each part of disposable baby diaper

Previous studies have explored the diapers composition with other benefits such as preventing leakage of excreta thus maintaining the dryness of skin and provide convenience for disposal. Disposable baby diaper is composed of some basic components as describe in Fig 2.1.

The top sheet layer draws moisture into diaper and allow liquids to pass through to keep the baby's skin dry. Moreover, polypropylene fibers are obtained from melt brown which brings softness and comfort to that part of diaper in the direct contact with baby's skin (Ng et al., 2013).

Acquisition layer allows a good distribution and diffusion of liquid. The absorbent core (AC) mainly consists of a mix of the superabsorbent polymer and fluff pulp and is the main part of disposable baby diaper structure because it keeps moisture and liquids away from baby's skin to maintain dryness and healthy. Superabsorbent polymer is the common ingredient in all diapers which has the property of absorbing and retaining in few seconds (Gontia & Janssen, 2016). Fluff pulp is naturally occurring cellulose material that absorb moisture.

The black sheet is an outer part of diapers and it prevents moisture from transferring to the baby's clothing, it is made up of polyethylene and polypropylene inner wrap to provide softness and comfort.

In additional element comprises features principally designed to guarantee good fit for the diapers such as flexible films, outer polyethylene films, adhesive, and lotion (Rai et al., 2009).

2.4 Materials of Disposable baby diapers

An average diapers weighs between 1.4 and 1.8 ounces and primarily made up of cellulose (30-40%), propylene, polyethylene and superabsorbent polymer (SAP) (Płotka-Wasylka et al., 2022). Cellulose, derived from wood pulp or cotton linters provides strengthen, durability, and absorbency. Polypropylene serves as waterproof backing sheet, waistband and leg cuffs while polyethylene forms a soft breathable liner and wrapping material. Superabsorbent polymers typically sodium polyacrylate or polyacrylic acid, absorbs up to 30times their weight in liquid ensuring dryness and comfort. As well as a minor number of tapes, elastic and adhesive materials, adhesive materials are used to hold diapers component together and prevents leaks. Therefore, these material combine to create a diaper that is light weight ,flexible and effective with less impact on the environment (Cordella et al., 2015).

However, the structure of old nappies was basic compared to modern diapers. They usually consist of a single absorbent layer that came into direct contact with the infant's skin Due to the absence of advanced absorbent materials, these nappies had limited capacity to retain moisture, making frequent changing necessary in maintaining hygiene comfort. Care givers used different folding techniques depending on cultural practices and personal preference, all aimed at ensuring proper fit and preventing leakage (Tokat et al., 2024). Despite their low absorbency and need for frequent changing, they provided a practical solution for managing infant hygiene (Tokat el al., 2024). This understanding forms the basis for interpreting the diagram of old nappies and their components as shown in Figures 2.2 and 2.3.

Figure 2.2: Traditional old nappies (Tokat. C., Rickman, N. C., $ Bearer, C. F.2023)

Figure 2. 3: Dressing a child using traditional nappy (Knisley,2020; Diaper kind, n.d.)

2.5 Factors considered when choosing disposable baby diapers of various brands

The study was aimed at analyzing absorption rate of disposable baby diapers of various brands. To achieve this purpose, descriptive and explanatory study design were used to analyze the data collected through survey questionnaires. Basing on the survey questionnaire, it is a recommended that the manufacturing firm's management and parents are advised to consider the following

2.5.1 Softness

The softness of the diapers is very important because the baby's skin is still delicate and sensitive therefore make sure that the diaper is made up of soft materials so that good air circulation around the baby's bottom area is maintained.

2.5.2 Price and quality

This study aimed at advising parents to understand that high quality diapers does not guarantee the quality level. Many affordable diapers are also very good quality therefore, we advise to research the features provided rather than looking at the price of the diapers.

2.5.3 Good absorbency

The first thing parents should consider in choosing a diaper for their baby's is to make sure that the diaper is leak-proof. A diaper must have the ability to absorb quickly with good stability as well as maximum capacity. In addition, the diaper is also not easy to loosen. Therefore, parent should know that leaking diaper can cause the baby's skin to become moist and cause skin irritation. However, it is important to choose a diaper that is anti-clot and super thin as well there is no good osmosis, so it can keep baby's bottom dry

2.6 Challenges and opportunities

The use of disposable baby diapers poses significant environmental, health, economic and social challenges for example waste generation, non-biodegradable materials, skin irritation, chemical exposure, high costs and parental stress. However, opportunities exist for innovation, sustainability, and improved accessibility such as developing biodegradable materials, eco-friendly alternatives like cloth and compostable diapers, designing better absorption and leak protection system. Additionally, education and awareness can promote proper use and disposal while regulatory frameworks can standardize safety and quality.

Research and development can drive the creation of new materials, manufacturing process, and innovative designs ultimately leading to a more sustainable, healthy and accessible diapering solution for families worldwide.

2.7 Impact on Infant Skin Health

Infant skin is highly sensitive and prone to irritation. Prolonged exposure to moisture can lead to diaper rash. High absorbency diapers reduce skin wetness and help maintain dryness thereby minimizing irritation (Stamatas et al., 2018).

2.8 Real world performance verses laboratory testing

Most diapers studies are conducted in laboratories under controlled conditions. However, these conditions may not reflect real life usage. Factors such as baby movement, pressure, and repeated wetting affect diaper performance.

Research shows that some diapers perform differently in real life situations compared to laboratory results (Gupta et al., 2021) Therefore, combining both testing approaches provides more accurate results.

2.9 Technological advancement in diaper design

Modern diapers include innovations such as ultra-thin absorbent cores, wetness indicators, improved elastic fitting, and leak protection systems. Some diapers also include skin friendly features and eco-friendly materials (Mendoza et al., 2019; Cordella et al., 2015). These advancements aim to improve comfort, performance, and environmental sustainability (Mendoza et al., 2019)

2.10 Environmental concerns

Disposable diapers contribute significantly to environmental pollution due to their non-biodegradable materials. Large volumes of diaper waste end up in landfills (Cordella et al., 2015).

Sustainable alternatives such as biodegradable and reusable diapers are being developed, although challenges such as cost and accessibility remain (Cordella et al., 2015).

2.11 Summary of literature review

The literature review shows that the absorption rate of disposable baby diapers is mainly influenced by material composition and structural design. Diapers contains superabsorbent polymer (SAPs) demonstrate higher absorption capacity and better moisture retention. The different layers of the diaper also contribute to effective liquid distribution and dryness.

Studies indicate virions in absorbency among different brands, however, comparative research is limited and often inconsistence due lack of standardized testing methods. Most of studies rely on laboratory conditions, which do not fully reflect real world usage.

The literature as highlights the importance of absorbency in maintaining infant skin health as higher absorbance reduces the risks of irritation. Despite these findings, gaps remain in standard evaluation and realized performance analysis. Therefore this study aims to address these gaps through a comparative and practical assessment of diaper absorption rates across brands

CHAPTER 3: MATERIALS AND METHODS

3.0 Introduction

This chapter covers research design, preparation of saline solution, sampling techniques, research instrument, data collection procedures, data presentation and analysis of method.

3.1 Research design

This research was both from field based and experimentally based. The field study involved both collection of disposable baby diapers such as soft care, cucttic pamper, Mami love and baby love diaper from different sellers and experimental based study involved the determination of absorption rate of baby diapers by measuring the weight of dry and wet diapers. The independent variable of the experiment was the diaper brands and dependent variable was absorption rate of the diaper.

3.2 Preparation of saline solution

To prepare a 0.9% saline solution, materials such as distilled water, sodium chloride (NaCl), electronic scale, stirring rod and clean container were needed. A bout 9 g of sodium chloride (NaCl) was measured using an electronic scale. The scale was calibrated to ensure accurate measurement. The weight of the sodium chloride used was recorded.

Afterwards, 1000ml of distilled water was measured and poured it into a clean container. The weighed sodium chloride was added slowly to the distilled water while stirring with a stirring rod until sodium chloride was completely dissolved. Stirring was continued until the solution was homogeneous and clear and the solution was verified whether has reached a concentration of a 0.9% (9 g of NaCl per1000 ml of distilled water)

3.3 Collection of materials

Disposable baby diaper samples were purchased from a local market located in lwakhakha along mbale lwakhakha highway. Five brands of disposable baby diapers were collected and labelled A, B, C, D, and E as shown in Figure 3.1. These brands were chosen because were the commonly used baby diapers found in the market. In this study, three (n=3) diaper samples for each brand were chosen and the average and the standard deviation of absorption rate was calculated and the results were analyzed in form of graphs and tables.

(a) (b)

(c) (d) (e)

Figure 3.1: Different types of diapers; (a) Soft care, (b) Cucttic, (c) Pamper, (d) Mami love

3.4 Determination of absorption rate

Firstly, the dry disposable baby diaper was weighed using electronic scale and then recorded as W_1. Secondly, the bucket was filled with enough saline solution and then the dry disposable baby diaper was completely submerged into the saline solution and left for 2 hours. The wet disposable baby diaper was removed and hung on a retort stand until no liquid drops off. Afterwards, diaper was removed and weighed and its weight was recorded as W_2.

The absorption rate (%) β of disposable baby diapers was calculated using the equation 3.1 and the results were tabulated in the Table 4.1.

$$\beta = \left[\frac{W_2 - W_1}{W_1} \right] \times 100, \quad (3.1)$$

Where, W_2 is Weight of a wet diaper and W_1 is Weight of dry diaper.

3.5 Comparison of absorption rates

After results were tabulated, further analysis was conducted through plotting graphs using excel software. Graph of average absorption rate against various brands was used to compare the quality of the diapers. The graph used was in form of bar graphs.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.0 Introduction

This chapter consists of the results of analyzing the absorption rate of disposable baby diapers of various bands and comparison of the results. This was done by measuring the weight of dry and wet disposable baby diapers and then determines the absorption rate of each brand.

4.1 presentation of the results of the study

This section presents the findings of the study based on the data collected during the experiment. The results are analyzed and interpreted to show variations in absorption rate among different disposable baby diaper brands.

Row data of different brands of diapers obtained experimentally in the laboratory following the required procedures were recorded as in table 4.1

Table 4.1: Row data of different brands of diapers obtained experimentally in the laboratory following the required procedures

Brands		**Weight of dry disposable of baby diaper (g)**	**Weight of wet disposable of baby diaper (g)**
A	**A_1**	**31.9**	**452.0**
	A_2	**32.1**	**452.9**
	A_3	**31.4**	**451.6**
B	**B_1**	**31.5**	**400.8**
	B_2	**31.3**	**400.0**
	B_3	**31.2**	**399.0**
C	**C_1**	**32.1**	**542.1**
	C_2	**32.0**	**542.0**
	C_3	**31.9**	**541.0**
D	**D_1**	**30.7**	**380.9**
	D_2	**30.5**	**380.0**
	D_3	**29.6**	**379.4**
E	**E_1**	**29.1**	**352.3**

	E_2	**29.0**	**352.2**
	E_3	**30.0**	**352.6**

4.1.1 Soft care brand

The absorption performance of the soft care diaper brand was investigated under the specified experimental conditions, and the results obtained are presented in table 4.1.

Table 4.2: The absorption rate of soft care diaper (brand A)

Brands		**Weight of dry disposable of baby diaper (g)**	**Weight of wet disposable of baby diaper (g)**	**Absorption rate (%)**
A	**A_1**	**31.9**	**452.0**	**1317**
	A_2	**32,1**	**452.9**	**1311**
	A_3	**31.4**	**451.6**	**1338**

The figure 4.1 shows the absorption rate of soft care brand. As seen the absorption rate of soft care brand is in the range of 1311 - 1338 wt % with an average of 1322 wt %. These average value of absorption rate is lower than 1698 wt% which was the recommended absorption rate of baby diapers according to (Bachra et al., 2020) .

A bar graph of absorption rate against soft care brand was then plotted using row data in table 4.2 as in Figure 4.1

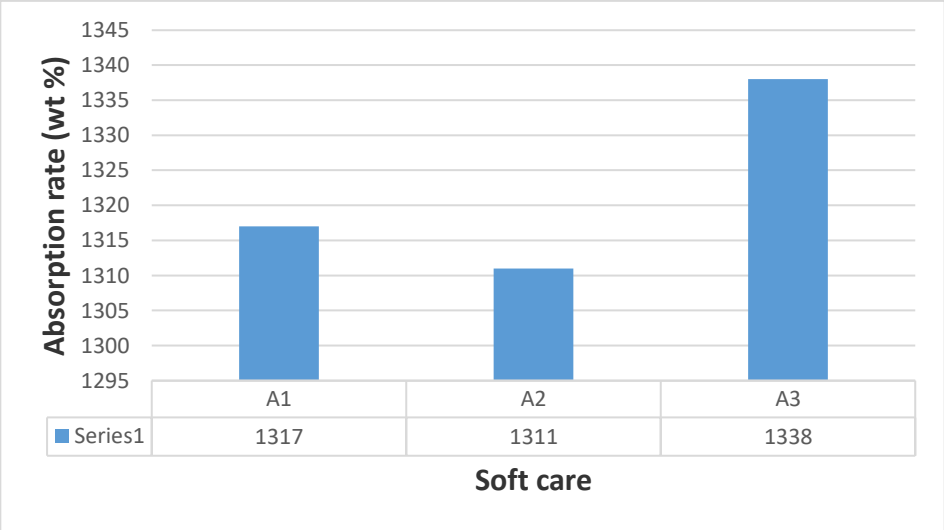

Figure 4.1: Absorption rate of soft care

From the graph, the relationship between A1, A2 and A3 shows a slight variation in absorption rates within the same soft care diaper brand. All three samples have values that are very close, indicating consistent performance, but there is a small difference in magnitude. A3 has the highest absorption rate, A1 is slightly lower and A3 has the lowest. This means that while the brand performs uniformly, A3 absorbs the most liquid, followed by A1, and then A2. Overall, the relationship reflects a gradual increase from A2 to A1 to A3, showing minor experimental differences between the samples.

4.1.2 Cucttic brand

The absorption rate of the cucttic diaper brand was investigated under the specified experimental conditions, and the results obtained are presented in table 4.3.

Table 4.3: The absorption rate of cucttic brand (brand B)

Brands		Weight of dry disposable of baby diaper (g)	Weight of wet disposable of baby diaper (g)	Absorption rate (%)
B	**B_1**	**31.5**	**400.8**	**1172**
	B_2	**31.3**	**400.0**	**1178**
	B_3	**31.2**	**399.0**	**1179**

The figure 4.4 shows the absorption rate of cucttic brand. As seen the absorption rate of this brand is in the range of 1172- 1179 wt%, with an average absorption rate of 1176 wt%. These average value of absorption rate is lower than 1698 wt% which is the recommended absorption rate according to (Bachra et al., 2020) .

A graph of absorption rate against cucttic brand was plotted using row data in table 4.3 as Figure 4.2

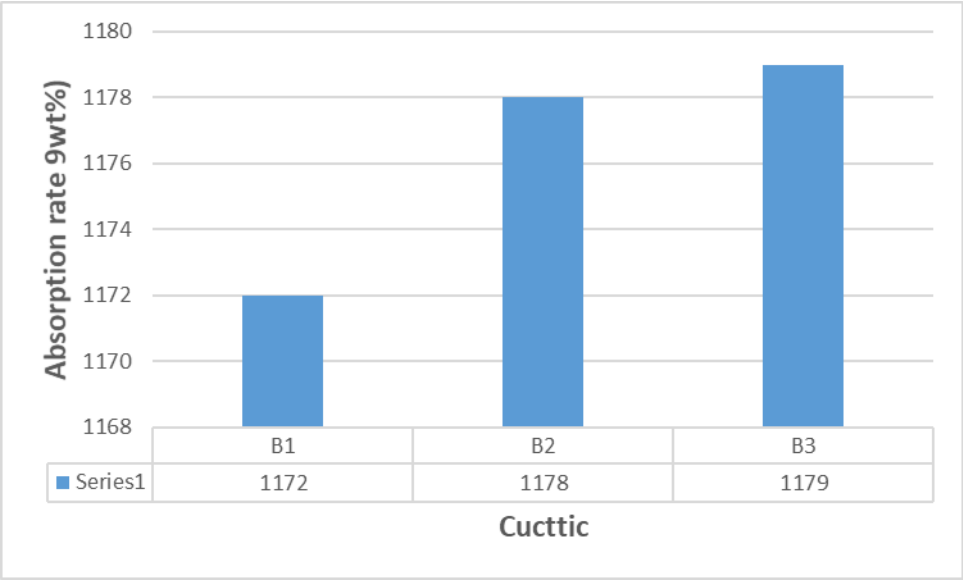

Figure 4.2: Absorption rate Cucttic brand

From the graph, B1, B2 and B3 show a slight increasing trend, where B1 is the lowest, B2 is higher, and B3 is the highest. The differences are small indicating consistent performance across the samples.

4.1.3 Pamper brand

The absorption performance of the pamper diaper brand was investigated under the specified conditions, and the results obtained are presented in table 4.4

Table 4.4: The absorption rate of pamper brand (brand C)

Brands		**Weight of dry disposable of baby diaper (g)**	**Weight of wet disposable of baby diaper (g)**	**Absorption rate (%)**
C	**C_1**	**32.1**	**542.1**	**1589**
	C_2	**32.0**	**542.0**	**1594**
	C_3	**31.9**	**541.0**	**1596**

Figure 4.5 shows the absorption rate of pamper brand. As seen the absorption rate of this brand is in the range of 1589 - 1596 wt%, with an average absorption rate of 1593 wt%. These average value of absorption rate is lower than 1698 wt% which is the recommended absorption rate of baby diapers according to (Bachra et al., 2020).

A graph of absorption rate against pamper brand was plotted using row data in table 4.4 as shown in the Figure 4.3

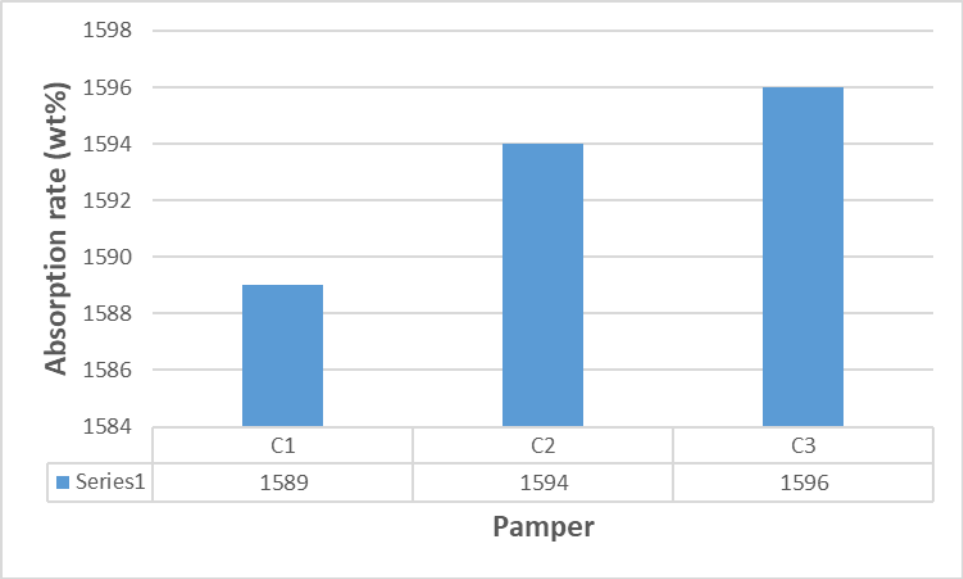

Figure 4.3: Absorption rate of pamper

From the graph, the relationship between C1, C2 and C3 shows a steady increase in absorption rate, where C1 is the lowest, C2 is higher, and C3 is the highest. The small differences indicate improvement from C2 to C3.

4.1.4 Mami love brand

The absorption performance of the Mami love brand was investigated under the specified experimental conditions, and the results obtained are presented in table 4.5.

Table 4.5: The absorption rate of Mami love brand (brand D)

Brands		Weight of dry disposable of baby diaper (g)	Weight of wet disposable of baby diaper (g)	Absorption rate (%)
D	D_1	30.7	380.9	1141
	D_2	30.5	380.0	1146
	D_3	29.6	379.4	1182

Figure 4.6 shows the absorption rate of Mami love. As seen the absorption rate of this brand is in the range of 1141 - 1182 wt%, with an average absorption rate of 1156 wt%. These average value absorption rate is lower than 1698 wt% which is the recommended value of absorption rate according to (Bachra et al., 2020).

A graph of absorption rate against Mami love was plotted using row data in table 4.5 as shown in the Figure 4.4

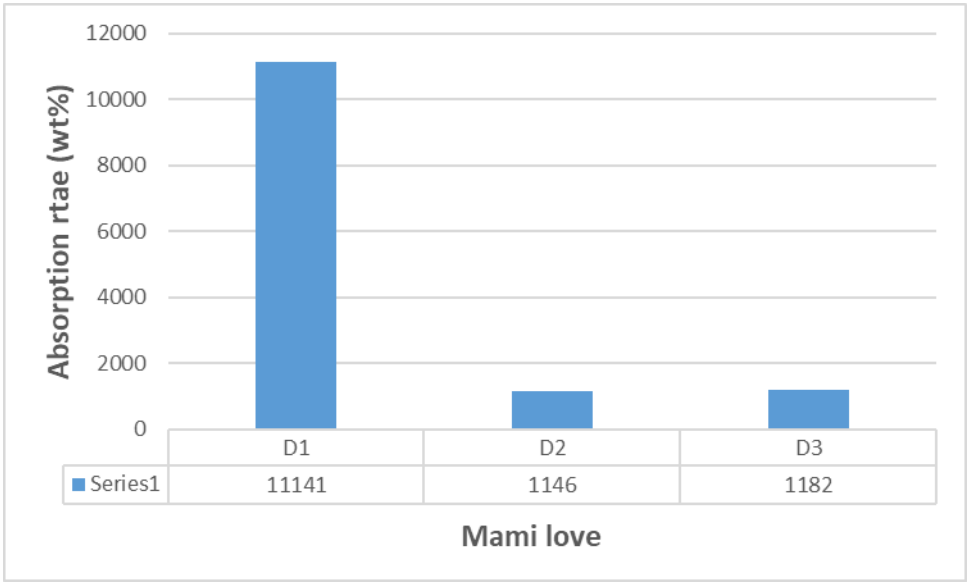

Figure 4.4: Absorption rate of Mami lover diaper

From the graph, D3 has the highest absorption rate, followed by D2 and D1 has the lowest. The specific absorption rates are 1141 wt% for D1, 1146 wt% for D2 and 1182 for D3. All three are within the brands stated rage of 1141-1182wt%

4.1.5 Baby love brand

The absorption rate of the baby love diaper brand was investigated under the specified experimental conditions and the results obtained are presented in table 4.6.

Table 4.6: The absorption rate of baby love brand (brand E)

Brands		**Weight of dry disposable of baby diaper (g)**	**Weight of wet disposable of baby diaper (g)**	**Absorption rate (%)**
E	**E_1**	**29.1**	**352.3**	**1111**
	E_2	**29.0**	**352.2**	**1114**
	E_3	**30.0**	**352.6**	**1075**

Figure 4.7 shows the absorption rate of baby love brand. As seen the absorption rate of this brand is in the range of 1075 - 1114 wt%, with an average of 1100 wt%. These average value of absorption rate is lower than 1698 wt% which is the recommended absorption rate of diapers according to (Bachra et al., 2020).

A bar graph of absorption rate against baby love brand was plotted using row data in table 4.6 as shown in the figure 4.5

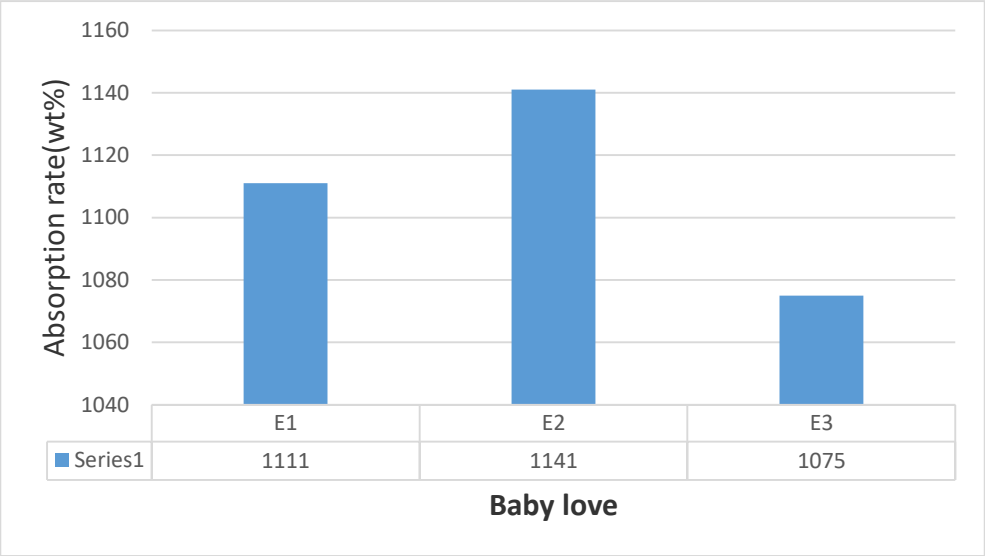

Figure 4.5: Absorption rate of baby love

From the graph, E2 exhibits the highest absorption rate at 1141wt%, followed by E1 at 1075% and E3 has the lowest rate at 1075wt%. Th relationship shows that the absorption capacity varies significantly between these specific samples

4.2 Comparison of the absorption rate

The comparison of the absorption rates of the five diaper brands was carried out under specified experimental conditions and the results obtained are presented in table 4.7.

Table 4.7: The average absorption rate of different brands of diapers

Brands		Weight of dry disposable baby diaper (g)	Weight of wet disposable baby diaper (g)	Absorption rate (%)	Average absorption rate (%)
A	**A_1**	**31.9**	**452.0**	**1317**	**1322**
	A_2	**32.1**	**452.9**	**1311**	
	A_3	**31.4**	**451.6**	**1338**	
B	**B_1**	**31.5**	**400.8**	**1172**	**1176**
	B_2	**31.3**	**400.0**	**1178**	
	B_3	**31.2**	**399.1**	**1179**	
C	**C_1**	**32.1**	**542.1**	**1589**	**1593**
	C_2	**32.0**	**542.0**	**1594**	
	C_3	**31.9**	**541.0**	**1596**	
D	**D_1**	**30.7**	**380.9**	**1141**	**1156**
	D_2	**30.5**	**380.0**	**1146**	
	D_3	**29.6**	**389.4**	**1182**	
E	**E_1**	**29.1**	**352.3**	**1111**	**1100**
	E_2	**29.0**	**352.2**	**1114**	
	E_3	**30.0**	**352.6**	**1075**	

The row data in table 4.7 for different brands was plotted on the same scale.

The average values of absorption rates of various brands was plotted on the same axis including the recommended value according to (Bachra et al., 2020) as in figure 4.6

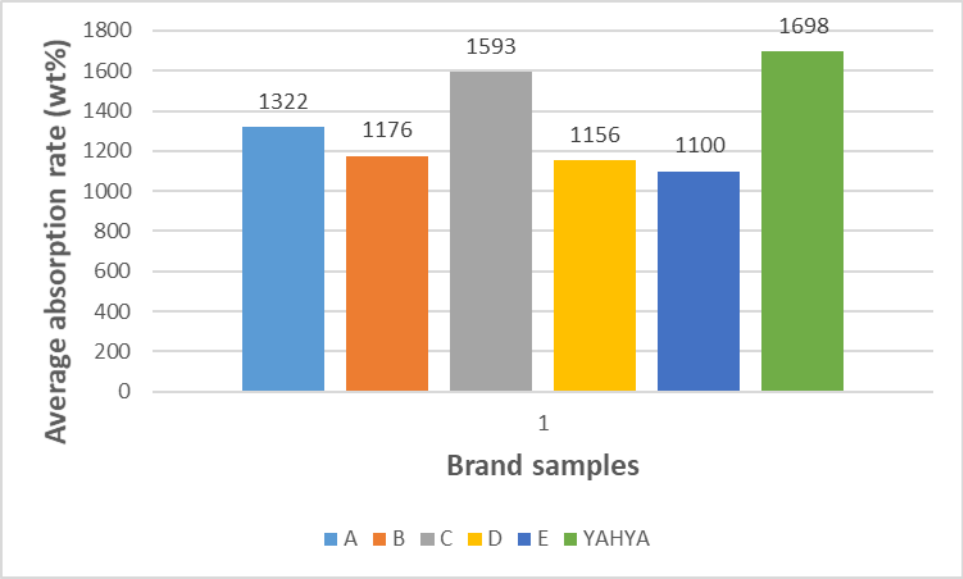

Figure 1: Comparison of absorption rate of diapers of various brands including the recommended value as reported by (Bachra et al., 2020).

From the graph, there is a clear variation in absorption capacity among the brands, showing that diaper performance differs significantly depending on the brand. Brands Yahya and C stand out as the most effective, while brand B, D, and especially E fall below the higher performance group.

The graph demonstrates a positive comparison where higher bars indicate better absorbency, and it highlights that not all diaper brands meet the same absorption standards, with some performing far better.

4.3 Discussion of the results

Since this study focuses on disposable baby diapers, saline solution (0.9% w/v/NaCl) was chosen as simulation of human urine. The results of average absorption rate of brands A, B, C, D, and E are illustrated in table 4.7. The brand samples of disposable baby diapers were purchased of the

same size (size 2), but based on the results, it can be seen that they have different absorption rate for each baby diaper brand.

As shown in Figure 4.8. The results show significant variation in absorption rate among the tested brands. Brand C demonstrated the highest absorption rate of (1593 %) followed by brand A (1322%) and brand B (1176%). Brand D, and E showed relatively lower absorption rate with Brand E having the lowest absorption rate (1100 %). But still the absorption rates are lower than the recommended value according to (Bachra et al., 2020).

These findings suggest that Brand C diaper may provide better leakage protection and longer usage times due to their superior absorption rate. In contrast, Brand E may require more frequent changes, potentially leading to increased costs and inconvenience for parents(Sachidhanandham & M, 2020). Therefore, Brand C shown to be the diaper sample that can absorb more liquid than the other diaper samples.

The differences in the absorption rate of the diaper samples is due their superabsorbent polymer (SAP) content and the quality of superabsorbent polymer (SAP) (Bachra et al., 2020). In this case, both fluff pup and superabsorbent polymer (SAP) have reached their maximum capacity since any force was applied. This is why it can be seen that an enormous amount of liquid is absorbed by the diaper.

Also the differences in absorption rate may be attributed to variation in diaper designs, and manufacturing processes (Tilouche et al., 2021). Therefore, future research should investigate these factors to optimize diaper performance.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter consists of conclusion basing on the specific objectives and recommendations.

5.1 Conclusion

Saline solution was prepared successfully which was used to test absorption rate of disposable baby diapers of various brands. The analysis of the absorption rate of disposable baby diapers from various brands was done and Baby love brand exhibited the lowest absorption rate of 1100 wt%. However, pamper brand exhibited the highest absorption rate of 1593 wt% for all the diaper brands studied. As the absorption rates for all the diaper brands under study was below 1698 wt% as reported by (Bachra et al., 2020). Meaning that the quality of the diapers sold in Uganda is of a quality below the recommended standard.

5.2 Recommendation

The following areas are recommended for further studies

1. Revisiting the material composition to enhance absorption rate
2. Further studies can be done upon this research by using other solutions.
3. Design optimization analysis.

REFERENCES

Al-Sagarat, A. Y., & Al-Kharabsheh, A. (2017). Traditional practices adopted by jordanian mothers when caring for their infants in rural areas. *African Journal of Traditional, Complementary and Alternative Medicines*, *14*(1), 1–9. https://doi.org/10.21010/ajtcam.v14i1.1

Bachra, Y., Grouli, A., Damiri, F., Bennamara, A., & Berrada, M. (2020). A new approach for assessing the absorption of disposable baby diapers and superabsorbent polymers: A comparative study. *Results in Materials*, *8*(October), 100156. https://doi.org/10.1016/j.rinma.2020.100156

Castrillon, N., Molina, M. E., Fu, H., Roy, A., Echeverria, M., & Toombs, J. (2019). Super absorbent polymer replacement for disposable baby diapers Tribological Studies on Tungsten-Aluminium Coatings View project Super absorbent polymer replacement for disposable baby diapers. *Commodity Polymer Project*, *October*, 1–6. https://doi.org/10.13140/RG.2.2.15095.98720

Cordella, M., Bauer, I., Lehmann, A., Schulz, M., & Wolf, O. (2015). Evolution of disposable baby diapers in Europe: Life cycle assessment of environmental impacts and identification of key areas of improvement. *Journal of Cleaner Production*, *95*, 322–331. https://doi.org/10.1016/j.jclepro.2015.02.040

Dey, S., Purdon, M., Kirsch, T., Helbich, H. M., Kerr, K., Li, L., & Zhou, S. (2016). Exposure Factor considerations for safety evaluation of modern disposable diapers. *Regulatory Toxicology and Pharmacology*, *81*, 183–193. https://doi.org/10.1016/j.yrtph.2016.08.017

Gontia, P., & Janssen, M. (2016). Life cycle assessment of bio-based sodium polyacrylate production from pulp mill side streams: Case study of thermo-mechanical and sulfite pulp mills. *Journal of Cleaner Production*, *131*, 475–484. https://doi.org/10.1016/j.jclepro.2016.04.155

Kamat, M., & Malkani, R. (2003). Disposable Diapers: A Hygienic Alternative. *Indian Journal of Pediatrics*, *70*(11), 879–881. https://doi.org/10.1007/BF02730591

Khoo, S. C., Phang, X. Y., Ng, C. M., Lim, K. L., Lam, S. S., & Ma, N. L. (2019). Recent technologies for treatment and recycling of used disposable baby diapers. *Process Safety and Environmental Protection*, *123*(December), 116–129. https://doi.org/10.1016/j.psep.2018.12.016

Mendoza, J. M. F., D'Aponte, F., Gualtieri, D., & Azapagic, A. (2019). Disposable baby diapers: Life cycle costs, eco-efficiency and circular economy. *Journal of Cleaner Production*, *211*, 455–467. https://doi.org/10.1016/j.jclepro.2018.11.146

Mendoza, J. M. F., Popa, S. A., D'Aponte, F., Gualtieri, D., & Azapagic, A. (2019). Improving resource efficiency and environmental impacts through novel design and manufacturing of disposable baby diapers. *Journal of Cleaner Production*, *210*(November 2018), 916–928. https://doi.org/10.1016/j.jclepro.2018.11.046

Ng, F. S. F., Muthu, S. S., Li, Y., & Hui, P. C. L. (2013). A critical review on life cycle assessment studies of diapers. *Critical Reviews in Environmental Science and Technology*, *43*(16), 1795–1822. https://doi.org/10.1080/10643389.2012.671746

Ntekpe, M. E. M. E., Mbong, E. O. E. . E. O., Edem, E. N. E. ., Hussain, S., Edem, N. E., Hussain, S., Ntepke, E. ., Mbong, E. O. E. . E. O., Edem, E. N. E. ., & Hussain, S. (2020). Disposable Diapers: Impact of Disposal Methods on Public Health and the Environment OPEN ACCESS. *American Journal of Medicine and Public Health*, *1*(2), 1–7.

Oliver, E. (2024). *The business of Dublin in the early 20th century : An overview of the retail and financial sector Published by : Old Dublin Society The business of Dublin in the early 20th century : An overview of the retail and financial sector*. *71*(2), 236–250.

Płotka-Wasylka, J., Makoś-Chełstowska, P., Kurowska-Susdorf, A., Treviño, M. J. S., Guzmán, S. Z., Mostafa, H., & Cordella, M. (2022). End-of-life management of single-use baby diapers: Analysis of technical, health and environment aspects. *Science of the Total Environment*, *836*(April). https://doi.org/10.1016/j.scitotenv.2022.155339

Prasad, H. R. Y., Srivastava, P., & Verma, K. K. (n.d.). *Diaper Dermatitis- An Overview*. 635–

637.

Rai, P., Lee, B. M., Liu, T. Y., Yuhui, Q., Krause, E., Marsman, D. S., & Felter, S. (2009). Safety evaluation of disposable baby diapers using principles of quantitative risk assessment. *Journal of Toxicology and Environmental Health - Part A: Current Issues*, *72*(21–22), 1262–1271. https://doi.org/10.1080/15287390903212246

Ran, H. (2018). *INTERNATIONAL NEWS AGENCIES IN THE ERA OF GLOBAL COMMUNICATIONS : CCTV ' s CONTRA- FLOW AND THE FACTORS THAT INFLUENCE U . S . MEDIA ' S SELECTION OF NEWS ABOUT CHINA*.

Sachidhanandham, A., & M, P. (2020). A review on convenience and pollution caused by baby diapers. *Science and Technology Development Journal*, *23*(3), 694–707. https://doi.org/10.32508/stdj.v23i3.2399

Tilouche, R., Debbabi, F., Sayeb, S., & Ben Hassen, M. (2021). Development of a new global quality index for evaluating baby diaper customer desirability: a useful tool for manufacturer. *Journal of the Textile Institute*, *112*(12), 2021–2038. https://doi.org/10.1080/00405000.2020.1862518

Tsigkou, K., Tsafrakidou, P., Zafiri, C., Soto Beobide, A., & Kornaros, M. (2020). Pretreatment of used disposable nappies: Super absorbent polymer deswelling. *Waste Management*, *112*(October), 20–29. https://doi.org/10.1016/j.wasman.2020.05.028

Zissis, G., Bertoldi, P., Serrenho, T. (2018). *Update on the Status of LED-Lighting world market since 2018, EUR 30500 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-27244-1, doi:10.2760/759859, JRC122760*. https://doi.org/10.2760/759859