A study by Toxics Link

Toxics Link
for a toxics-free world

Phthalates or Phthalates-free Diaper: Money Matters

INTRODUCTION

BABY DIAPERS

Diaper is a type of napkin that absorbs urine or feces and keeps babies dry and comfortable without soiling their clothes or surroundings. Diapers are light, very absorbent, and resistant to leaks. Disposable diapers are thrown away after use and hence provide hygiene, skin protection to the baby and thereby convenience for a mother.

A market survey agency has forecasted that "In India revenue in the baby diapers segment amounts to be US$5,428m in 2020 and the market is expected to grow annually by 4.9% (CAGR 2020-2023).[1] Generally, disposable diapers consist of several chemicals such as phthalates, dioxins, sodium polyacrylate, tributyl-tin, volatile organic compounds, dyes, fragrances, etc. These chemicals may cause itching, rashes and various health problems such as damaged immunity, hormone interferences, cancer, respiratory problems etc. However, with rising consumer awareness on the negative impact of these chemicals, the consumers are looking for more environment-friendly natural products. Now a days there are wide variety of products available in the market which claim to be largely chemical-free, made up of natural materials and safe for use.

Additionally, environmental concerns have also come up as a key factor to drive the demand for biodegradable diapers. Traditional diapers are made up of petrochemical-based materials & plastics hence do not degrade well in a landfill which eventually can pollute the ground water. Some of the other major factors driving the demands of biodegradable diapers include increasing awareness about personal hygiene, increased paying capacity, availability of variants etc.[2]

Moreover, various manufacturers are coming up with biodegradable baby diapers made of bio fibers such as from corn, bamboo, organic cotton instead of plastic and avoiding or minimizing uses of chemicals such as bleaching with chlorines, latex, dyes or fragrances.

The global biodegradable diaper market is expected to grow at a CAGR of 10.3% during 2019-2024[3]. IMARC Group expects the global biodegradable diaper market to reach a value of US$ 5.46 billion by 2026, exhibiting strong growth during the forecast period (2021-2026).[4]

GLOBAL BIODEGRADABLE BABY DIAPERS MARKET: KEY PLAYERS

Some of the key players in the global biodegradable baby diapers market are GroVia, Naty AB, Hengan International Group Company Limited, Seventh Generation, Inc., The Honest Company, The Hain Celestial Group, Inc., Kimberly-Clark Corporation, Kao Corporation, Bumkins Company, The Procter & Gamble Company, Svenska Cellulosa AB, Ontex Group, Unicharm Corporation, and others.

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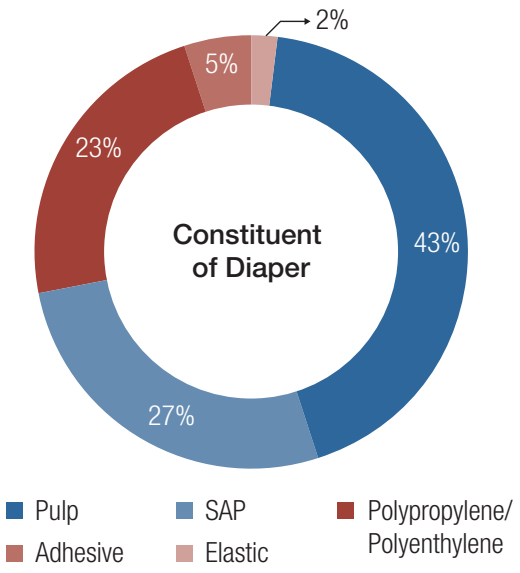
COMPOSITION OF DIAPER

The constituent of diapers are also varying from diaper to diaper. Diapers are generally made of either **non-biodegradable** petrochemical-based materials & plastics such as cellulose, polypropylene, polyester, super absorbent polymer (SAP: acrylonitrile) and polyethylene or **biodegradable** fibers including cotton, bamboo, starch, and other natural materials which are arranged in different layers (inner layer or top sheet, absorbent core, waterproof outer shell) to provide optimal absorption of urine and faeces. Besides, cloth diapers are also available in the market but they need to be removed and washed immediately.[5]

FIGURE 1 Constituent of Diaper



Children are more vulnerable to phthalate exposures because of their hand-to-mouth behaviors, floor play, and developing nervous and reproductive systems. Phthalates in disposable diapers are also a concern for babies as diapers are in direct contact with their skin for a long period of time each day for 2-3 years.

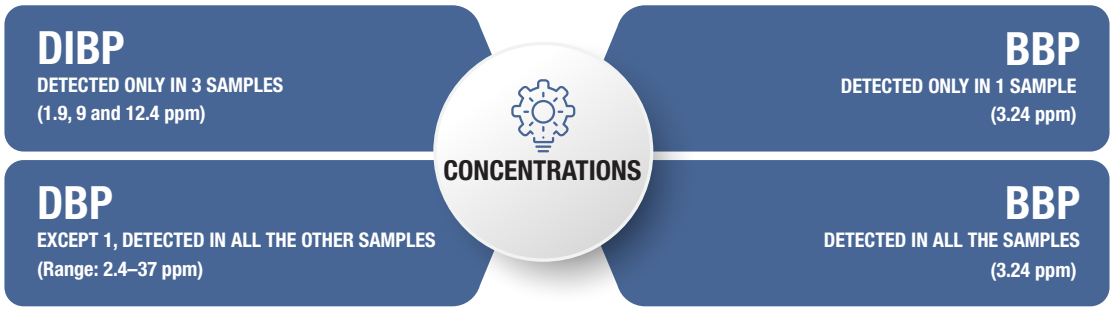
PHTHALATES IN DIAPERS

Phthalates[6] are added on the top sheet and outer sheet to provide the flexibility and elasticity to the disposable diapers so that it can easily stretch to provide comfort to the baby. Besides, phthalates are also present in velcros, fragrances and printing ink used in diapers.

There are studies depicting the presence of phthalates in diapers and exposure to babies. **Park et.al** (2019) had quantified phthalate contents in baby diapers collected from Korea, Japan, Finland, France, Greece, and the United States. They have detected DBP and DEHP in every diaper. The highest concentration of phthalates that they reported is 1,609.7ppb. They have inferred that as diapers are in direct contact with the skin of babies for a longer period, there is a possibility that significant amount of phthalates could be absorbed into the reproductive system through the skin.[7]

Razavia et al. (2017) from Iran University had detected the phthalates in the topsheet of the baby diapers using nanoparticles of magnetic polyaniline-coated chitosan.[8] **Ishii et al**. (2015)[9] had screened seven phthalates in the topsheet of five disposable diapers sold in Japan. They have also estimated amounts of phthalates to which newborn babies were exposed by wearing diapers. DEHP and DBP were detected in samples respectively in the concentration ranges of 0.1 to 0.6 ppm and 0.1 to 0.2 ppm.

Phthalates are esters of phthalic anhydride and belong to the family of high-volume industrial chemicals. They are used as plasticizers which determine the physical properties of polymer products. Phthalates are added to plastics to increase their flexibility, transparency, durability, pliability and elasticity. When added to plastics, phthalates allow the long polyvinyl molecules to slide against one another. They are blended within the plastic article during the manufacturing process.Phthalates are categorized as low and high, on the basis of their molecular weight. Depending upon their molecular weight, phthalates have different industrial applications and impact on environment and health. At present, 23–26 different types of phthalates are commercially available, which are used as plasticizers, solvents and emulsifiers.



Toxics Link analyzed 20 samples of diapers in 2019 collected from Delhi market and found the presence of four phthalates DEHP, DIBP, BBP and DBP in varied concentration. DEHP, DBP, total phthalates were detected in all analyzed samples.

RATIONALE OF THE STUDY

Phthalates are well-known endocrine disrupting chemicals (EDCs) which have an adverse effect on human health especially children, who are the most vulnerable to its exposure. Research studies have confirmed the leaching of phthalates from diapers which can have health impacts of phthalates on children. The four phthalates DEHP, BBP, DIBP, and DBP are highly hazardous especially for children.

However, there was no study conducted in India, so **Toxics Link undertook a primary research study in 2019** to detect the presence of high content of phthalates in baby diapers, which are easily and commonly available in the Indian market at an affordable price.

SUMMARY OF RESULTS FROM PREVIOUS STUDY IN BABY DIAPERS

- In 2019 Toxics Link has done primary research and twenty diaper samples were analyzed for detecting four types of phthalates DEHP, BBP, DIBP, and DBP as well as the total phthalate content.
- DEHP, DBP, were detected in all analysed samples.
- The highest phthalate content reported was 302.25ppm
- DEHP, the most toxic phthalate was observed in the range of 2.36ppm to 264.94ppm in the analyzed samples

REGULATIONS

There are regulations in many countries to ensure availability of good quality diapers in the market. In EU the General Product Safety Directive (2001/95/EC) is applicable to diapers which is a general regulation for products to provide risk assessment, disposal dossier and procedure to withdraw products from the market.,

In China, there is a mandatory regulation in place for baby diapers under GB 15979-2002: Hygienic Standard for disposable sanitary products (HS Code of 9619001000 Pull-up baby diapers). Though there are no specific guidelines for phthalate content but microbial indicators and other test results are necessary to be reported.

In Korea, the Korean Ministry of Food and Drug Safety (MFDS) regulates baby and adult diapers under "Sanitary Products". The regulation has restrictions on substances such as fluorescent whitening agent, formaldehyde, chlorinated phenols, phthalates and heavy metal contaminants.

In Japan under "Voluntary Standards for Safety and Hygiene of Non-woven Fabrics for Disposable Diapers-2015" phthalates are classified as prohibited chemical substances and are therefore not allowed to be used in manufacturing of diapers. However, they are allowed to be used as a catalyst in the manufacturing of non-woven fabrics for diapers.

In India no specific guidelines are applicable on diapers.

TABLE 1 Assessment of phthalates in diapers available in the Indian market

Serial	Bis (2-ethylhexyl) Phthalate (DEHP)	Benzyl Butyl Phthalate (BBP)	Di-isobutyl Phthalate (DIBP)	Di-butyl Phthalate (DBP)	Total Phthalate	Cost/unit
TL-D 1	47.98	BDL	12.36	3.73	64.07	9.48
TL-D 2	14.79	BDL	1.92	2.35	19.06	8.60
TL-D 3	4.96	3.24	BDL	BDL	8.2	7.96
TL-D 4	5	BDL	BDL	9.42	14.42	7.37
TL-D 5	4.98	BDL	BDL	8.36	13.34	9.20
TL-D 6	2.84	BDL	BDL	17.59	20.43	9.37
TL-D 7	5.66	BDL	BDL	19.36	25.02	11
TL-D 8	5.28	BDL	BDL	29.01	34.29	7.5
TL-D 9	8.37	BDL	BDL	5.3	13.67	16.83
TL-D 10	4.11	BDL	BDL	10.61	14.72	9.9
TL-D 11	7.84	BDL	BDL	2.92	10.76	20
TL-D 12	2.36	BDL	BDL	9.93	12.29	6.25
TL-D 13	9.52	BDL	BDL	10.76	20.28	6.25
TL-D 14	45.03	BDL	BDL	17.09	62.12	10
TL-D 15	5.89	ND	BDL	8.51	14.4	10
TL-D 16	264.94	ND	BDL	37.31	302.25	7.37
TL-D 17	4.59	ND	BDL	6.99	11.58	9.37
TL-D 18	88.26	ND	BDL	19.13	107.39	9.48
TL-D 19	62.02	BDL	9.05	7.31	78.38	5.28
TL-D 20	12.8	ND	BDL	7.33	20.13	6.25

Concentration in ppm

During the previous study, it was found that there are many manufacturers selling diapers which are not commonly available in the local market but available online and they are claiming their products as eco-friendly, organic or/and chemical-free. Moreover, some of the products also labeled as phthalates-free are also exorbitantly priced as compared to the commonly available diapers in the market. And these products are largely being sold through online platforms. The cost details of the samples analyzed during the study are depicted in graph shown below

FIGURE 2: Comparative analysis of cost of samples analyzed in 2019 study

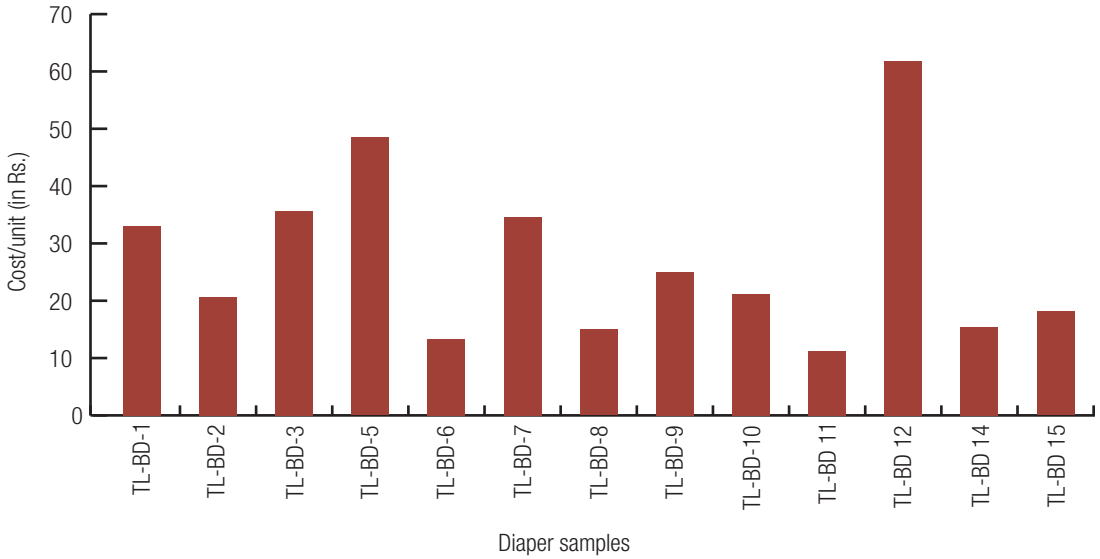
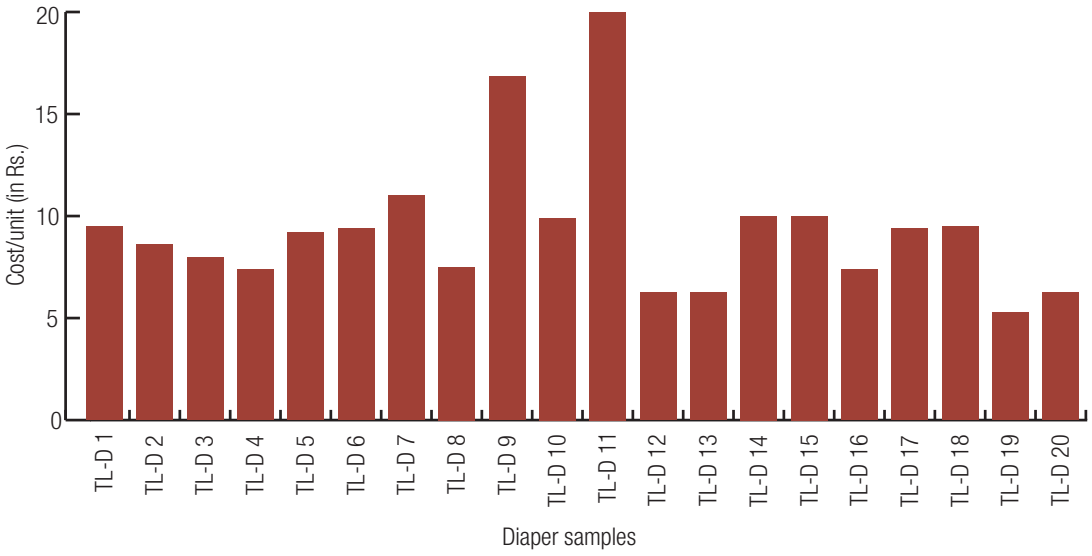


FIGURE 3: Comparative analysis of cost of samples tested in present study.



To detect the presence of phthalates in biodegradable/organic/ chemical-free baby diapers

To highlight the disparity in quality and cost of the products available in market

In this context the study was an impediment to understand the actual claim of these products and also to bring the issue of deep social divide to access the safe products in India. Further the study also aims to get a reflection on the previous study of Toxics Link on the underlying need of a regulation on Phthalates in diapers in India.

ANALYSIS OF THE RESULTS OF PRESENT STUDY

In the **current study**, fifteen samples were collected from e-platforms which are marketed as organic, bio, chemical-free or phthalates-free products. Out of 15 samples two are reusable organic cloth diapers. We had selected these cloth diapers based on increasing demand for this product among consumers and claim of the manufacturers of being organic and chemical-free. They were analyzed in the Spectro Analytical Lab in Delhi using the standard protocol for Phthalates testing.

- Phthalates have been detected in well-known brands and in samples that had been mentioned as safe and non-toxic for children (0% phthalates)
- DEHP was reported in fourteen out of the fifteen samples tested whereas BBP was reported in seven samples.
- DEP & DIBP were not detected in any of the analyzed samples

The results of the present study are as mentioned in table 2:

TABLE 2: Assessment of Phthalates in diapers in current study

Serial	Instructions	Bis (2-ethylhexyl) Phthalate (DEHP)	BBP	DEP	DIBP	Total phthalates	Cost/unit
TL-BD-1	non-woven topsheet from cornstarch, absorbent pad from fiber crops and aloevera, backsheet non-woven polyprpoylene and polyurethane	2.51	ND	ND	ND	2.51	33
TL-BD-2	cotton, aloevera	ND	4.05	ND	ND		20.66
TL-BD-3#	topsheet and bottomsheet from bamboo of finland. Zero phthalates	6.72	ND	ND	ND	6.72	35.7
TL-BD-4*	free of any chemicals, organic cotton	5.89	ND	ND	ND	5.89	499
TL-BD-5	topsheet from corn fiber	2.2	ND	ND	ND	2.2	48.47

Serial	Instructions	Bis (2-ethylhexyl) Phthalate (DEHP)	BBP	DEP	DIBP	Total phthalates	Cost/unit
TL-BD-6#	phthalates-free; 100% cotton; Non-woven Fabric, Breathable PE Film,SAP Polymer, Velcro	2.26	3.97	ND	ND	6.23	13.32
TL-BD-7	Not mentioned	7.42	4.12	ND	ND	11.54	34.58
TL-BD-8	Not mentioned	7.78	ND	ND	ND	7.78	15
TL-BD-9*	organic bamboo, Free from heavy metals and allergens.	2.34	ND	ND	ND	2.34	25
TL-BD-10*	100%biodegradable organic; Cloth Like Topsheet, Super Dry Layer, Certified Organic Bamboo Pulp Core, Velcro Side Tape	2.43	ND	ND	ND	2.43	21.22
TL-BD 11	not mentioned	2.45	1	ND	ND	3.45	11.18
TL-BD 12	not mentioned	2.42	1.41	ND	ND	3.83	61.88
TL-BD 13	not mentioned	2.4	ND	ND	ND	2.4	970
TL-BD 14	non-woven polypropylene, paper, polyethylene, polypropylene, polyurethane	3.71	1.75	ND	ND	5.46	15.38
TL-BD 15	non-woven fabric	4.93	4.44	ND	ND	9.37	18.14

Concentration in ppm

ND: Not Detected

 # Samples type were labeled safe and Phthalates free, however, Phthalates were found

**samples were labeled chemicals free or organic but Phthalates were detected in testing*

ANALYSIS OF DEHP IN DIAPER SAMPLES

- Figure 1 represents the comparative analysis of DEHP in samples so tested.
- Max value of DEHP was reported to be 7.78ppm in sample TL-BD 8 followed by 7.42 ppm in sample TL-BD 7 while the lowest value of DEHP detected was 2.2 ppm in TL-BD 5.
- The average concentration of DEHP was reported at 3.69ppm

CONCENTRATION OF BBP IN DIAPER SAMPLES

- The maximum level of BBP was reported to be 4.44 ppm in sample TL-BD 15. These are significantly higher than average (1.39 ppm) of all the diapers that were analyzed.
- In seven samples BBP was below detection limit

FIGURE 3: Concentration of DEHP in diaper samples (in ppm)

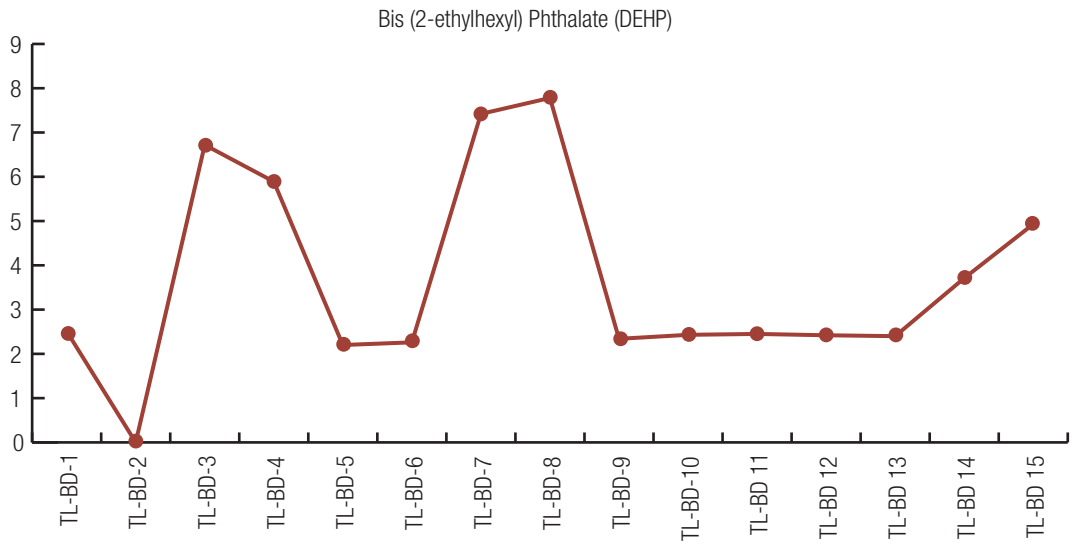
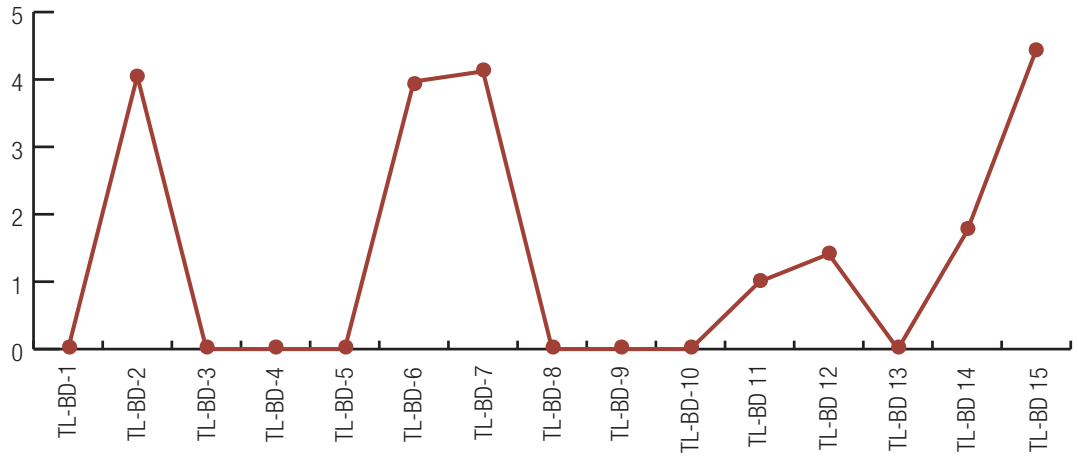


FIGURE 4: Concentration of BBP in diaper samples (in ppm)



OBSERVATION

The present study is in the continuation of our previous study which was undertaken in 2019 to find out the presence of Phthalates in baby diapers available in the Indian market. In that study, samples included for analysis were most commonly available, economically affordable disposable diapers and DEHP, the known toxics phthalates, were reported in all the tested samples.

However, for the present study samples selected for analysis are imported and purchased from e-platforms and labeled as premium, chemical-free, organic, bio-degradable, or some even claim to be phthalate-free.

The study shows the presence of DEHP in all samples except in one out of fifteen while BBP was found in 50% of the samples tested. Though the concentration of these phthalates is quite low in comparison to the findings of our previous study; however, the exposure of the same may cause health hazards amongst infants and toddlers for being continuously exposed to these harmful chemicals. Further the results represent that the claim by manufacturers of being phthalate-free or chemical-free is not true.

The low concentration of Phthalates in diaper samples of the current study reflects that these manufacturers are producing diapers with the intent of producing disposable diapers with low or no phthalates which is a positive development. However, the study has shown another side of the story. In the previous study, it was found that the same manufacturers are also producing diapers at a high phthalates content with much lower price. This clearly indicates the double standards on the part of the manufacturers, as they intend to produce high quality and safe products to well-off customers while the less privileged people have to depend on the unsafe products. This is a clear violation of the fundamental rights of access to the healthy products.

HEALTH IMPACTS

- Endocrine disruptor
- Liver/kidney/lung damage
- Cancer
- Altered reproductive development & male fertility issues
- Type II diabetes & obesity
- attention-deficit/hyperactivity disorder (ADHD)
- Neurodevelopmental issues
- Increased allergic symptoms
- Metabolic disorders
- Autistic behaviors
- Lower cognitive and motor development

As an example, P & G, a leading manufacturer of diapers is selling diapers in two different categories of products- Pampers and Pampers Premium Care to cater to different socio -economic strata of the society, as the price difference is exceptionally high for the two products

Further the study concludes that it is possible to manufacture diapers without phthalates, and the manufacturers needs to come forward and voluntarily phase out phthalates from their diapers considering the large-scale health and environmental hazards. Moreover, the government should come up with stringent regulations and facilitate the phase out of phthalates from the products.

KEY TAKEAWAYS

The study busts the myth that phthalates-free diapers cannot be produced and sold in the Indian market.

The manufacturers are quite aware of toxicity of Phthalates and are interested in producing phthalates-free diapers which are safe to health.

It shows the double standards of the manufacturers like P & G to sell different categories of products without showing any concern to the health and environmental impacts health and environment.

The cost difference reflects the state of Indian society where the poor do not have access to safe products.

There is an urgent regulation required to phase out the phthalates from diapers and also fix the standards to prevent any anomaly.

Labelling should be mandatory and monitoring is key the to success of safe products.

ENDNOTES

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