

N E A R T A

A fresh look at diapers

DIAPERS AND THE ENVIRONMENT



NHUNG T. PHAM & ERIC W. BROWN

P.O. BOX 3206

WAKEFIELD, MA 01880

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Introduction

The impact of choosing disposable versus reusable diapers on the environment has in recent years largely been overlooked. An unreviewed study published in 1978 indicated that while disposable diapers generate more solid waste, they also consume less water than their reusable counterparts¹. This was a flawed conclusion based largely on demonstrable clerical and mathematical errors², but few have so noted and many still accept its original conclusions as factual. The situation has been exacerbated by a preponderance of tactical studies funded by disposable diaper companies³ and a simultaneous dearth of independent studies and studies funded by reusable diaper companies⁴.

This paper will survey existing research not just on diapers themselves but also on a other topics like pediatric care, groundwater pollution, and landfill construction, and view the diaper situation from an environmental standpoint. Ultimately it will show how diapering choice can affect the environment by looking at the different key areas that diapers affect.

Solid Waste

Quite possibly solid waste is the one thing people think about most when one discusses the impact of diapers on the environment. The amount of solid waste generated by disposable diapers is legendary, and in many people's minds somewhat exaggerated⁵. The fact that many believe it to be larger than it really is does not make it insignificant, however. Disposable diapers are still the third largest individual constituent of municipal solid waste accounting for

¹ See the *Study of Environmental Impacts of Selected Disposable Versus Reusable Products with Health Considerations (SW-152c)* by Robert Levesque, Richard O. Welch, Ron Fellman, Chuck Romine, Robert G. Hunt, Mary Simister, & Dan Keyes; U.S. Environmental Protection Agency, 1978.

² For all the details see *An Analysis of the Diaper Portion of SW-152c* by Nhung T. Pham & Eric W. Brown; NEARTA, Saugus, MA, September 2009.

³ There are many. Probably the two most significant studies commissioned by disposable diaper companies are *Disposable Versus Reusable Diapers: Health, Environmental and Economic Comparisons* by Arthur D. Little, Inc., Cambridge, MA, 1990; and *Energy and Environmental Profile Analysis of Children's Single Use and Cloth Diapers: Revised Report* by Franklin Associates, Ltd., Kansas, 1992 (this is the same company that contributed to the earlier mentioned flawed SW-152c study, and they also released more work on the same topic in the intervening years).

⁴ About the only two significant ones are *Diapers in the Waste Stream: A Review of Waste Management and Public Policy Issues*, December, 1988 and *Diapers: Environmental Impacts and Lifecycle Analysis* January, 1991, both by Carl Lehrburger, Jocelyn Mullen, & C. V. Jones; Energy Answers Corporation, Albany, NY, January, 1991. The problem is likely to get worse as reusable diaper companies are getting smaller. As observed in "Why Are Diaper Services Disappearing?" by Linda Baker, *E/The Environmental Magazine* (downloaded from <http://www.emagazine.com/view/2997> on Oct. 12, 2009), over 87% of the diaper service companies in the U.S. have gone out of business since the late '80s. If the reusable diaper companies are not strong enough to fund their own studies or raise awareness enough to encourage independent studies, virtually all studies will be funded by disposable diaper companies.

⁵ The "National Customer Service Conference Focus Group Project", EPA, December, 1999 found that many people believed soiled disposable diapers were the single biggest constituent of landfill trash.

probably somewhere between 1.5% and 4% of the total⁶. Even if one decides to ignore such studies, it is still fairly straightforward to obtain a rough estimate of the mass of solid waste generated by alternative means. By using census data to calculate the approximate number of children using diapers within a given population. This can be generally done by summing all of the children who are less than the age of three, 40% of the children who are between the ages of three and four, and 2% of the children aged four⁷. This will always produce an underestimate, as it makes no attempt to count adult diaper users (which includes approximately half of all nursing home patients⁸) and it is assuming that all feces in disposable diapers is being properly flushed.

While it has been estimated that an individual child using disposable diapers was responsible for approximately a ton of solid waste over the course of a year⁹, it is fairly easy to get another independent estimate of the post consumer solid waste portion based upon the amount of urine children produce over time¹⁰ taken in conjunction with the average weight of a disposable diaper¹¹ (with associated packaging¹²) and the number of diaper changes pediatricians recommend per day¹³, and it comes out to be (on the low side) about a quarter of a ton per year.

No matter how one approaches the problem, it adds up to a significant quantity of solid waste.

⁶ The two previously mentioned studies by Lehrburger et al go into great detail on the quantity of solid waste produced by disposable diapers. Specific amounts we take from other sources. The lower bound is taken from *Municipal Solid Waste in the United States: 2007 Facts and Figures* by the Office of Solid Waste, EPA, November, 2008 as being 1.5%. This number was provided by Franklin Associates, Ltd. based upon (according to page 109) “confidential industry sources”. Franklin Associates, Ltd. also performs studies on behalf of the disposable diaper industry, so they are perhaps not the most unbiased of sources. The World Health Organization cites a number of “over 4%” (which we conservatively round down to 4%) based upon empirical analysis of household waste in “Waste disposal and landfill: Information needs” by R. Taylor & A. Allen in *Protecting Groundwater for Health: Managing the Quality of Drinking-Water Sources*, WHO, October, 2004.

⁷ Various studies look at this. One such is “Bladder Control in 1-4 Year Old Children in the Eindhoven and Kempen Region in 1996 and 1966” by B. E. Horstmanshoff, G. J. Regterschot, E. E. Nieuwenhuis, M. A. Bennings, W. Verwijfs, & J. J. Waelkens; *Nederlands tijdschrift voor geneeskunde*, January, 2003.

⁸ According to the National Association for Continence in their article “Bladder and Bowel Health” available online at: <http://www.nafc.org/bladder-bowel-health/>

⁹ In the previously mentioned Lehrburger studies.

¹⁰ From *The Standardization of Terminology of Lower Urinary Tract Function in Children and Adolescents: Report from the Standardization Committee of the International Children’s Continence Society* by T. Nevéus et al, *J of Urology*, March, 2009.

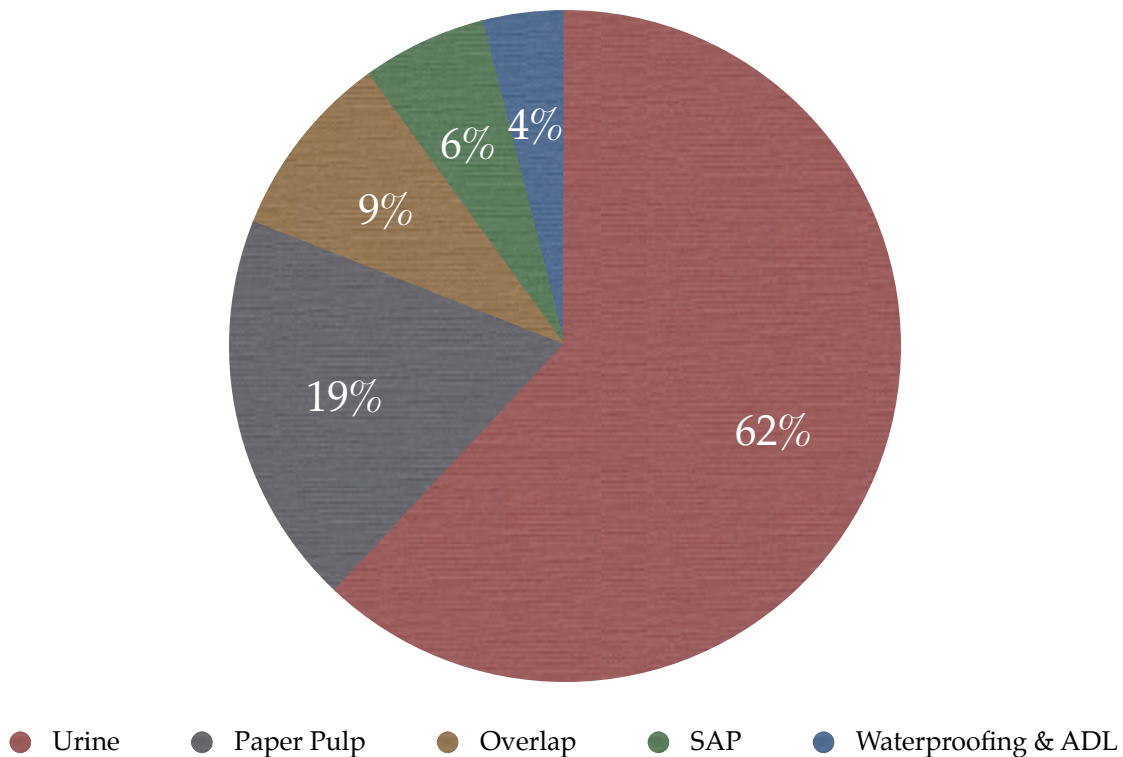
¹¹ We obtained this by weighing a representative sample (different sizes and vendors) of disposable diapers.

¹² Ibid. Expect roughly a pound of diaper packaging for every 100 diapers.

¹³ Regardless of what type of diapers children wear, parents should change them three to eight times per day; from T. Nevéus et al already quoted above.

It is also a growing problem. The amount of disposable diaper waste has been increasing over the years¹⁴. Plus, as recycling becomes more effective in other areas, disposable diapers will inevitably account for an increasing percentage as they have a negligible recycling rate¹⁵.

Chart 1: Waste Breakdown per Diaper (by Weight)



As chart 1 above indicates, most of the mass of a discarded used diaper (assuming proper flushing of solids) is urine¹⁶. The breakdown of the individual diaper components varies wildly from brand to brand, and so the numbers above should be taken to be approximates and not representative of any one particular individual diaper. Generally speaking, the greater the mass of super absorbent polymers (SAP) a disposable diaper contains, the lower the mass of paper pulp (the overlap slice accounts for this variability). Acquisition distribution layers (ADL) are used to help urine more efficiently distribute throughout the SAP. The paper pulp (which includes a portion of the overlap) tends to be made from virgin fluffed wood pulp¹⁷ and would be recyclable a good number of times were it not part of a diaper.

¹⁴ According to *Municipal Solid Waste in the United States: 2007 Facts and Figures* by the Office of Solid Waste, EPA, November, 2008. Table 15 tracks a steady increase from 1960 through 2007.

¹⁵ Ibid. Table 16 notes no significant recycling of disposable diapers.

¹⁶ The overall ratio of urine to diaper mass was obtained as a by-product of the overall solid waste figures we calculated above. The rough breakdown of the diaper itself is derived from “Absorbency: Does Anybody Really Know What It Is?” by Carlos Richer, pp. 10-12, Richer Investment S.A. CV, Memphis, TN, Nov. 2006.

¹⁷ The article “Recofluff: Can Recycled Fiber Deflect Consumer Hostility?” James P. Hanson, Nonwovens Industry, March 1991, considered the possibility of using some recycled content. The FAQs from the Pampers and Huggies sites both indicate that as of Oct. 2009 only virgin wood pulp is used for their respective diapers.

The obvious solution to the problem of solid waste generated by single-use disposable diapers is to favor reusable diapers instead. With reusable diapers all the urine gets processed as sewage; it does not get incinerated or land-filled. Individual reusable diapers typically get used lots of times; after their original users outgrow them, they get handed down not just to younger siblings but even get traded (along with tips on how to best maximize the life expectancy of each reusable diaper) amongst communities of reusable diaper users.¹⁸ Furthermore, when reusable diapers have finally passed their useful life as diapers, they tend to get reused as rags.¹⁹ The greater the number of uses per individual diaper, the smaller amount of solid waste produced overall.

Another potential solution proposed by the disposable diaper industry has been to create dedicated disposable diaper composting facilities. Experiments along this line have been being conducted since the late '80s²⁰, and while the technology has generally been proven to work for the non-plastic portion of disposable diapers, it has not yet been shown to be commercially feasible²¹. Even if this approach does work, it does not attempt currently to deal with the plastic portion of disposable diapers that cannot be composted, and it fails to address any of the other environmental impacts that will be discussed in following sections of this paper. It is also too early to gauge the full environmental impact introduced by these composting facilities themselves, but clearly once it has been factored in it will also shift the equation.

Non-Renewable Resource Consumption

One of the key problems not addressed by composting disposable diapers is the simple fact that a percentage of each disposable diaper cannot be composted because it is made from plastic. Besides not being compostable, plastic is traditionally made from fossil fuels, and it is questionable whether or not the estimated 82,000 tons of plastic consumed by disposable diapers in the U.S. annually²² represents the optimum use to society of this limited resource.

This can be somewhat reduced by use of the so-called biodegradable diapers which typically use a mixture of resin and starch for the plastic portion. These do not completely remove the use of plastic, still take years to break down in ordinary composting conditions, and are still the subject of questions regarding the completion of the biodegrading process²³. They are not currently offered by any of the largest disposable diaper manufacturers²⁴.

¹⁸ See for example <http://www.diaperswappers.com> and http://community.livejournal.com/cloth_diapering

¹⁹ Most diaper services sell their retired diapers as rags. Searching online via a Google query like <http://www.google.com/search?q=%22diaper+rags%22> will bring up numerous diaper rag suppliers.

²⁰ See *Project Summary: Diaper Industry Workshop Report* by Clyde Dial & George Wahl; EPA, Cincinnati, OH, June 1991.

²¹ The most recent such attempt is in New Zealand. More information about this EnviroComp experiment can be found on their Web site at: <http://www.envirocomp.co.nz/> but the general idea is that a commercial entity (currently partially funded by the disposable diaper industry) charges disposable diaper users a fee to compost their diapers. Participation (and the resulting additional trash separation required) is voluntary, but somewhat supported by local governments with a small subsidy.

²² See "The Ethics of Diapering" by Robert W. Hollis, *Mothering*, Fall, 1989.

²³ See "What a Bummer! The Social Shaping of the Diaper in North America" by Leslie Regan Shade, *HOST: An Electronic Bulletin for the History and Philosophy of Science and Technology*, V. 2, January, 1994.

²⁴ Based on a quick survey of their respective Web sites, October 2009.

Diapers also consume significant fossil fuels for energy during the manufacturing process and the cleaning process (for reusable diapers). In 1978, the manufacturing energy costs were greater than the washing energy costs, and in the past few decades clothes washers have been becoming more efficient consumers of electricity²⁵.

As with the solid waste issue, the simplest solution is to prefer the use of reusable diapers. Their use has been consistently shown to use less fossil fuel since it was first seriously reviewed in 1978²⁶. The difference has only grown more pronounced as toilet and clothes washer efficiency has improved in the subsequent decades.

Water Consumption

Probably the most frequently quoted area in which disposable diapers supposedly have a lesser negative impact on the environment than reusable diapers is that of water usage. Many assume that the washing required for reusable diapers consumes more water than the manufacturing process required for producing disposable diapers. Time and time again, however, the actual studies that make these claims tend not to survive close scrutiny.

Perhaps one of the most significant of these is the EPA's study, *SW-152c*²⁷. Although it was purported to show that disposable diapers required less water than reusable ones, when actually closely analyzed (and various mathematical and clerical errors corrected and the human feces component missing from the disposable side properly reapplied) it showed the opposite²⁸. The later Arthur D. Little, Inc. study²⁹ was directly funded by the disposable diaper companies and was found to share many of the same problems as *SW-152c*. It was likewise criticized for poor methodology, mathematical errors, and forgetting to include human feces when considering the disposable diaper side³⁰.

It must also be noted that as both toilet and clothes washer efficiencies improve over time the amount of water needed for reusable diapers decreases³¹. Neither present diapering solution is particularly good with regards to water conservation; neither side seems markedly better than the other with current technology in this category. As toilet and clothes washer efficiency continue to improve, however, it is likely that reusable diapers will become the more efficient consumers of water.

The common knowledge that reusable diapers are bigger consumers of water than disposable ones is not supported by present data — it is quite simply false.

²⁵ See the previously mentioned *An Analysis of the Diaper Portion of SW-152c* for more details.

²⁶ *Ibid.*

²⁷ More formally known as the *Study of Environmental Impacts of Selected Disposable Versus Reusable Products with Health Considerations (SW-152c)*, by Robert Levesque et al, U.S. Environmental Protection Agency, 1978. Criticisms of it at the time prevented it from ever being formally reviewed by the EPA; it was instead released with a disclaimer.

²⁸ Again see the previously mentioned *An Analysis of the Diaper Portion of SW-152c* for more details.

²⁹ Specifically *Disposable Versus Reusable Diapers: Health, Environmental and Economic Comparisons* by Arthur D. Little, Inc., Cambridge, MA, 1990.

³⁰ See "What a Bummer! The Social Shaping of the Diaper in North America" by Leslie Regan Shade, *HOST: An Electronic Bulletin for the History and Philosophy of Science and Technology*, V. 2, January, 1994.

³¹ See the previously mentioned *An Analysis of the Diaper Portion of SW-152c* for a table showing how water usage has dropped due to improved clothes washer technology.

Air and Water Pollution

There are other types of waste besides solid waste. Life cycles for both disposable and reusable diapers also create both waterborne and airborne wastes. These wastes arise not just from the manufacturing process for the diapers themselves, but also in the manufacturing process for things like soap (used in washing reusable diapers), the energy production process for running things like clothes dryers, and the transportation channel for shipping diapers from manufacturers to distributors (and ultimately consumers).

SW-152c was the pioneering study in this area, although many more recent reports have augmented it by considering additional factors that *SW-152c* ignored³². Once *SW-152c* has had its errors corrected, it shows that disposable diapers produce more air pollution and water pollution than reusable diapers³³. In some of these more modern studies (in particular the Carl Lehrburger ones) the difference is even greater. In the later of these two reports, it is observed that the various effluents from the various industries involved in making disposable diapers are much more dangerous than anything involved in the reusable diaper manufacturing process, including the initial cotton growing³⁴.

As it was with solid waste, favoring the use of reusable over disposable diapers reduces both airborne and waterborne wastes.

Considering Diaper Services

When analyzing reusable diapers, the distinction between home laundering and an external diaper service should be noted. As diaper services can process loads of far greater numbers of diapers, they have obvious economy of scale benefits. All the above mentioned studies that took the time to separately analyze the two approaches to cleaning reusable diapers found diaper services to be superior in virtually all respects with regard to minimizing environmental impact.

Conclusion

We reviewed the research in four key areas of the environmental impact of diapers. In three of these areas: solid waste, non-renewable resource consumption, and airborne / waterborne wastes, reusable diapers created less of a negative impact than their disposable counterparts. In the fourth area: water consumption, neither type of diaper emerged as a clear winner. Furthermore, in the particular cases of solid waste and non-renewable resource consumption, reusable diapers have *much* less of a negative environmental impact.

Overall when viewed from an environmental standpoint, reusable diapers represent the only responsible choice for diapering our babies.

Consequence

Unfortunately the truth about environmental impact is not going to convince everyone to eschew disposable diapers. People who currently use disposable diapers use them for a variety of reasons with the mistaken notion that disposable diapers are less environmentally harmful being just one. Possibly the most common reason cited is that of con-

³² See footnoted 3 and 4 for a list.

³³ See the previously mentioned *An Analysis of the Diaper Portion of SW-152c*.

³⁴ See the previously mentioned *Diapers: Environmental Impacts and Lifecycle Analysis*.

venience; others include health and cost. While in modern times there is really not that much difference in convenience³⁵, and health³⁶ and cost³⁷ both favor reusable diapers, these facts are not well known.

The only sure method to get people to change their habits is through education. The same sort of approach currently taken with recycling programs should be applied to diapers. Existing “reduce, reuse, recycle” literature should be augmented to include diaper information. People ought to be taught that reusable diapers have less of a negative environmental impact than disposable diapers, and that diaper services have a smaller environmental impact still. People should be taught that there are techniques to even further minimize both cost and environmental footprint of reusable diapers³⁸. People need to be fully informed in order to make responsible decisions.

³⁵ Even in 1990 Amy Dacyczyn estimated it at only half an hour extra per week on page 707 of the *The Complete Tightwad Gazette*, Random House, Inc., New York, NY, 1998. Reusable diaper technology has improved since then, so the difference is probably even smaller now.

³⁶ Both disposable and reusable diapers have been accused of increasing the rate of diaper rash. See the previously mentioned *SW-152c* and “What a Bummer! The Social Shaping of the Diaper in North America” for some examples. While other accusations have flown back and forth, see “Scrotal Temperature is Increased in Disposable Plastic Lined Nappies” by C-J Partsch, M. Aukamp, & W. G. Sippell, *Disease in Childhood*, October, 2000, pages 364-368 for what is possibly the only current reputable example in either direction.

³⁷ In previously mentioned *The Complete Tightwad Gazette* on page 179 author Amy Dacyczyn notes that in 1990 reusable diapers saved \$7.00 per week over disposable diapers. In the nearly two decades since then, prices have gone up making the savings even greater. Sometimes people are worried about the start-up cost of reusable diapers, but these start-up costs are often inflated as a single new reusable diaper can be obtained for \$10; see *Diaper Cost Comparison* by Nhung T. Pham & Eric W. Brown; NEARTA, Saugus, MA, October 2009 for more details.

³⁸ *Ibid.* Amy Dacyczyn discusses numerous methods of doing so (beyond the obvious case of air drying).