Commentary and Response: gDiaper Disposable Diapers comments on the City of Vancouver's Study of the Treatability of gDiaper Disposable Diapers and Their Impact on Sewer and Wastewater Systems

City of Vancouver
November 28, 2007

SUMMARY

The City of Vancouver has provided the manufacturer of gDiapers disposable diapers an opportunity to comment on the City's treatability and impact study and final report. The resulting Key Points and Discussion (Technical - Part I) and Key Points (Marketing – Part II) are listed in this paper as submitted by gDiapers manufacturer, with the exception of providing numbering for Key Points in Part II. Responses by the City of Vancouver follow, respectively. The City stands by its study, a basic look at the issue, and the study findings. The City agrees that additional in-depth research should be done to fully explore the collection and treatment system impacts and treatability issues raised.

PART I

KEY POINTS

1. Part 1 the testing performed by the City of Vancouver was reportedly done following the manufacturer's instructions for disposal. However, the steps described in the COV Report do not follow gDiapers' instructions for disposal. Therefore, these test results are inapplicable to gDiapers.

> **City of Vancouver Response:** The City followed the manufacturers' instructions on dismantling, agitation and dilution in Part 1 of the study, as detailed in the methodology of the report. In this portion of the study, the diapers were "ripped open & stirred," per the manufacturer's directions, as they would be if they were flushed down a single toilet, and they were subjected to the same dispersion forces in the collection system.

2. Part 2 of the two parts of the testing by the City of Vancouver assumed that the manufacturers' instructions were not followed, but the procedures described in the COV Report would not have been possible. (If gDiapers were flushed without following the instructions, the refill would not flush, therefore would not make it into the wastewater system.)

> **City of Vancouver Response:** In discussions with gDiapers prior to the study, the City was made aware of potential obstacles to introducing whole gDiapers. For this reason, Part 2 is not extensively discussed in the report, the conclusions of which are based almost exclusively on observations of the gDiapers that had been torn open, stirred and diluted prior to introduction. During the study, the City observed a fair amount of lag time in the absorption of water by the diaper pad which may allow for passage through a standard fixture into the collection

system. Further, the City has verified it is indeed possible to flush the diaper in its entirety. In a test case, the City was successful in flushing a whole diaper through an unmodified toilet fixture, clearing the bowl which did refill, despite assertions stated above. Therefore, the potential to flush a whole diaper does exist for the general public. In this case, the issues of concern would be clogging further into the collection system as the gdDiaper pad continued to swell after flushing and ragging at the pump stations, not performance within treatment plants.

3. In the "Physical Property Analysis" section of the COV Report, the steps reported did not reflect the conditions, which occur in real world sedimentation of gDiapers components. Therefore the test results are not applicable to gDiapers.

City of Vancouver Response: Testing performed followed standard laboratory methods for the wastewater industry and allowed comparison of different wastes using identical parameters. Additionally, the laboratory methods used are those which are required by EPA for reporting, and are standard for determining operational parameters at a municipal wastewater facility. The results were obtained using gDiapers. Therefore, the results are applicable to gDiapers.

4. The discussion of pump clogging in the Field Study, Part 1, of the COV Report notes the presence of other rag material. Therefore, the conclusions are not necessarily the results of gDiapers.

City of Vancouver Response: gDiapers were present in the rag material removed. Therefore, it is reasonable to conclude that gDiapers contribute to rag clogging.

DISCUSSION

1. The manufactures' instructions for disposal of the used gDiapers require the pad to be ripped open and stirred in the toilet bowl before flushing. This process substantially deaerates the diaper pad and disperses the components. What the City of Vancouver (COV) did on June 13, 2006, in Part 1 of its testing was to place the soaked pads of three diapers in a 5 gallon bucket and dumped the lot into a manhole. This procedure precluded the proper aeration and dilution of the pad components and inhibited the normal sedimentation which would occur in the clarifiers or sedimentation tanks of a wastewater treatment facility.

City of Vancouver Response: As previously noted, the City followed the manufacturers' instructions on dismantling, agitation and dilution in Part 1 of the study, as detailed in the methodology of the report. In this portion of the study, the diapers were "ripped open & stirred," per the manufacturer's directions, as they would be if they were flushed down a single toilet, and they were subjected to the same dispersion forces in the collection system. The discussion comment is inaccurate and fails to consider the study methodology, which may be reviewed for better understanding. Also, it should be noted that a gDiaper representative

reviewed the study prior to its taking place. No concerns regarding Part 1 of the study were raised at that time.

2. In Part 2 of the COV testing, four whole pads were soaked, ripped at the edges, and then dropped into manholes without stirring. In the real world, this procedure would not be possible. In the real world, the gDiapers would not flush from a toilet bowl without the separation and stirring specified in the gDiapers instructions. The super absorbent polymer (SAP) would have absorbed water and would have swelled, so the toilet bowl outlet would have been plugged. Therefore this part of the COV testing is simply not applicable to gDiaper usage by the populace.

City of Vancouver Response: As previously noted, the City was made aware of potential obstacles to introducing whole gDiapers prior to the study and for this reason Part 2 is not extensively discussed in the report. During the study, the City observed a fair amount of lag time in the absorption of water by the diaper pad which could allow for passage through a standard, unmodified toilet fixture into the collection system. Since then, the City has verified it is possible to flush an entire gDiaper, clearing the bowl which did refill, despite company assertions. Thus, the potential to flush a whole diaper does exist for the general public, as well, depending upon the specific toilet, saturation of the diaper and time allowed prior to flushing. In this case, the concern would be clogging further into the collection system, as the gdDiaper pad continued to swell after flushing, as well as concern of ragging at the pump stations. Note: The toilet that successfully passed a whole gDiaper pad is a "low-flow" 1.6 gpf model.

3. The COV Report includes some calculations. These include an estimate that 4% of the city's population of 154,800 or 6,200 are under 2.5 years and are in diapers and that those 2.5 years and under would have 6 diaper changes per day. This yields 37,200 soiled diapers per day. These numbers are reasonable.

However, there follows a calculation based on an assumed volume of 0.5 liters of fluff for gDiapers which is totally inappropriate. It does not relate the assumed volume of fluff to the total sewage flow, and it does not note that the volume of the fluff includes the water or sewage in which it flows.

The sanitary sewage generated by the 154,800 people in the City of Vancouver probably varies from an average of about100 gallons per capita per day (gpcpd) to a high of about 220 gpcpd and a low of about 42 gpcpd. On an average day the total flow would be about 154,800 x 100 = 15,480,000 gallons. Into this flow a probable maximum of 37,200 gDiapers might be introduced if all the babies in Vancouver were using them. That reduces to 1 gDiaper per 416 gallons. On a very low flow day, there would be 175 gallons for each gDiaper.

City of Vancouver Response: The amount of fluff in one medium gDiaper was measured by lab personnel employed by the City's wastewater treatment facility contractor. It is not an estimate. Also, the City uses average, not ranges. The 100 gallons

per day per person (gpcpd) is the average for City of Vancouver. Calculations provided in the City's report were intended as an estimate of volume for the purposes of total loading. The report does not derive any conclusions from these numbers. Nor does the report make any statements as to the impact of various volumes of diaper material. Therefore, relative concentration of the material is not significant to this study.

4. The COV Report asserts that the fluff does not settle, however, the manner in which the COV test was done was guaranteed to give that illusion. When the fluff has been separated and dispersed per the manufacturer's instructions, the fluff readily settles. This was shown in tests performed at Allison Laboratories in Hobart, Australia, and in tests by NSF Engineering and Research Services in May 2005. A standard flush of a new "low flow" water closet discharges about 1.6 gallons or 6 liters per flush. That in turn is further diluted in the sewage stream.

When there is inadequate dispersal, as was the case in the COV tests, the fibers of the fluff tend to bridge across a tapered container such as the Imhoff flask. This appears to be the reason for the COV results.

> **City of Vancouver Response:** The test procedure used is an industry standard and is considered a valuable and effective tool in evaluating and predicting settleability in a municipal wastewater facility. In this laboratory test, ¼ of a cup of material was diluted into one liter of water – twice as dilute as a medium gDiaper in a 6 liter flush – yet settling did not occur. Further, and also stated in the report, the diluted and disaggregated material was introduced well upstream of each pump station specifically to allow for additional dilution in the collection system to simulate real-world conditions. The City feels these methods were an adequate simulation of actual conditions. Neither the Allison Laboratories testing information (BOD/COD) nor NSF testing information (toilet fixture clearance) provided by gDiapers manufacturer prior to this study contained information regarding settling. If available, the City would be interested in reviewing any additional data from those tests, as well as evaluation of whether and how the procedure's efficacy might vary according to different material parameters across a broad spectrum of substances. However, an evaluation of the Imhoff cone as a laboratory device is beyond the scope of the City's study.

5. The COV Report notes adhesion of material including some gDiaper material downstream of the flapper of a swing check valve in the Sand Castle pumping station. Their assertion that it was a PAC gel (sodium polyacrylate gel) is certain evidence that the materials were not properly dispersed as would have been the case had the manufacturer's instructions been followed.

> **City of Vancouver Response:** The observation of adhesion is simply evidence that the material adheres to surfaces within the collection system. If diluting the material according to flush volume, physically agitating it prior to introduction to the collection system, and the further dilution and agitation of peak-time flow within the collection system is not sufficient to disperse the material to an extent

that would prevent this adhesion, then it is safe to say the material is not compatible with the collection system. In the study, adhesion of dyed gDiaper PAC was also observed on bar screens at the headworks of the Marine Park facility. This was after miles of agitation and dilution in the collection system.

6. The COV reports observing residue of gDiapers on the bar screens at the Marine Park Water Reclamation Facility and asserts that to be evidence of "the adhesive properties of the PAC/cellulose gel. The COV report further asserts that the gelatinous PAC/cellulose conglomerate can be expected to act like fats, oil & grease then ascribes this as a cause of clogging in municipal collection systems.

Because the COV did not follow the manufacturer's instructions, and, if they had, the dispersion would most probably have prevented the accumulations reported.

City of Vancouver Response: This comment does not reflect a complete understanding of the methods of the study. The gDiaper pads were adequately disassembled, agitated, and diluted prior to introduction into the collection system.

7. There appears to be some lack of understanding of BOD5 (5 day biochemical oxygen demand) and COD (chemical oxygen demand). BOD5 is a measure of the rate at which dissolved oxygen would be absorbed in the process of oxidizing the material. A low BOD5 indicates that the material oxidizes slowly, and if the material is discharged into a stream or river it will absorb oxygen at a lower rate than the river or stream would reaerate from dissolving gaseous oxygen from the surface. In this regard, toilet tissue and facial tissue (approved materials) are primarily cellulose.

The COD is simply a measure of the total amount of oxygen required to fully oxidize a material. It is an important property when evaluating the effects of highly reactive materials and gives a measure of the amount of oxygen required to be supplied as in aerobic digestion.

City of Vancouver Response: The City of Vancouver's Engineering Division maintains a high understanding of BOD5, as it is one of the principle means of evaluating the quality of effluent and the efficiency of the treatment process. BOD5 is also one of the parameters for which the City has a discharge limit under its National Pollutant Discharge Elimination System (NPDES) permit, requiring the City to maintain a viable working knowledge of the BOD5 test and implications of its results. While low BOD5 can indicate a uniformly slow decomposition rate, it can also indicate a material is only partially biodegradable or that a particular test seed (initial microbial population used in the test) has a long acclimation lag. A material that is 100 percent degradable but proceeds slowly could have the same BOD5 as a material that is only 5 percent biodegradable if the degradable portion is rapidly metabolized. Ultimately, while the testing period is standardized at 5 days, BOD5 is measured as a volume in mg/l without a time unit because it does not imply any specific decomposition rate curve. Discussion comment No. 7, above, is in error and fails to address this important point with respect to

BOD5 and gDiapers. The critical point here is that a material with a low BOD5 will not degrade to an appreciable extent in an aerobic treatment facility. Tissue is a form of cellulose which is readily settleable and is removed from the waste stream through physical, rather than biochemical, processes. Discharging water containing partially treated material to receiving waters would create a situation that environmental laws are designed to prevent.

8. The COV Report posits "...gDiapers Likely Route through COV Wastewater System". Because, contrary to COV's assertions, the manufacturer's instructions were not followed, this description is not possible and has little or no value.

> **City of Vancouver Response:** Again, the reader is referred to the study, in particular the methodology section, which describes the disassembly, agitation and dilution of the gDiapers, following manufacturer's instructions, prior to introduction to the collection system.

9. The subsection "Fluidized-Bed Furnace' speculates that cellulose, PAC, and rayon would reduce the efficiency of the furnace and require more diesel fuel to be consumed. The report ignores the fact that cellulose - and rayon is a form of cellulose - is a fuel in itself, and its oxidation, burning, in the fluidized bed furnace would add its own fuel, 8,000 to 17,000 Btu per pound on a dry basis depending on its form. This means that the presence of cellulose in any of its forms would actually reduce the diesel fuel requirement. Further, since cellulose is readily oxidized or burned, there should more likely be a reduction in the residue, and the products of combustion discharged into the air are unlikely to be measurably increased. The amount of ash created is unlikely to be increased if the furnace is operated properly.

> **City of Vancouver Response:** It is the PAC, not the cellulose, which is extremely hydrophilic and nonflammable, that will reduce the efficiency of the furnace by lowering the overall flammability of the sludge cake. This reduction in flammability is the reason for increased diesel fuel to supplement the poorer burn. The increase in CO2 and ash is simply a function of volume; more solids can be expected from the diversion of a solid waste stream (diapers) to the wastewater system and thus more organic material will be combusted. The City did not intend to imply that cellulose is not flammable. An expansion of this section of the report may be warranted to clarify these points.

10. The subsection "Ultra-Violet Disinfection" asserts that cellulose particulate matter that remains in the effluent is likely to interfere with the UV disinfection system. This assertion is based on the faulty procedures followed by COV during their testing. The assertion that the final effluent would be higher in suspended solids and COD and would contain a greater number of pathogens is speculation based on faulty testing. There is more likely going to be no measurable difference.

> **City of Vancouver Response:** The City disagrees with this discussion comment. Please see previous responses regarding methodology.

11. The COV report poses a number of questions. Had COV permitted the gDiapers representative to assist and advise on the proper test procedures, those questions could have been answered, and more useful and accurate results could have been obtained.

> **City of Vancouver Response:** While gDiapers was not involved in the study field work, the City actively consulted with gDiapers on the design of the study and solicited any relevant information or studies before beginning its work. The feedback and comments provided at that time by gDiapers were incorporated into the study design, as appropriate.

PART II

KEY POINTS

1. There are a number of concerns COV has raised which we would like to address in an in-depth, scientific study carried out by a qualified testing institution. COV have also suggested this in their conclusions.

> **City of Vancouver Response:** The City of Vancouver agrees a number of concerns raised would merit an in-depth, scientific study carried out by a qualified independent, academic institution.

2. These concerns are quite surprising to us, contrary to other tests that have been done in Australia, and have never been an issue in over 15 yrs of the product use in that country.

> **City of Vancouver Response:** The City requested but did not receive any testing information that specifically looks at potential impacts of this product within municipal collection and treatment systems or treatability within those systems. Nor is the City aware of any such study having been done previously. This was substantiated in discussions with gDiaper representatives. Tests have been done on the flushability of the product – whether it can clear the toilet bowl and household plumbing – as well as compostability of the product and performance in septic systems. The tests are informative, but not directly applicable to impacts within municipal collection and treatment systems. Nor do previous tests address treatability in municipal systems. "Flushable" is not the same thing as "treatable". Many things, such as plastics, medications, etc., are physically flushable, but should not be flushed down the toilet or sink. Introduction into the sewer system is not the preferred way to manage these and other waste materials that can potentially cause harm in the receiving waters. The City remains keenly interested in any relevant study information that may be available.

3. As mentioned previously we were excluded from the testing and feel that there are significant flaws in the way COV conducted the tests.

City of Vancouver Response: The City disagrees with gDiapers' statement asserting significant flaws. As noted, although gDiapers was not involved in the study field work, the City did actively consult with gDiapers on its study design and request any relevant information or studies before beginning its work. The feedback and comments provided by gDiapers were incorporated into the study design, as appropriate. The City felt it was important to conduct the field work as independently as possible for the integrity of the study.

4. One example was how gDiaper refills were introduced into their system. This was done not by flushing pads down a toilet but by dumping large buckets of material into manholes. This does not simulate real life conditions of mixing and dilution that would normally occur. Nor would this scenario occur, as gDiapers would not clear the toilet bowl if the explicit instructions (rip, empty contents and stir with swishstick before flushing) are not followed.

City of Vancouver Response: Please see responses to Part I, Key Points No. 2 and Discussion No. 2, above, regarding study methodology and noted successful test flush of an entire gDiaper.

5. Another concern raised was settlability of our product. Unfortunately the settlability test was done at a very small scale (in the equivalent of a large beer glass). We don't believe this to be an accurate test given that the actual settling tanks are ten or more feet in diameter.

City of Vancouver Response: The City disagrees with this statement. The test procedure used is an industry standard and considered an effective tool in evaluating and predicting settleability.

6. Inadequate settling lead the COV to assume that there would be several other serious implications. Whilst we understand COVs concern we do not feel this is in any way a viable scenario.

City of Vancouver Response: The City is not aware of any other studies performed specifically dealing with potential impacts within municipal collection and treatment systems, as well as treatability within those systems. Again, the City is recommending potential impacts to the collection and treatment system and treatability be researched and investigated further before gDiapers can be deemed compatible with the City's wastewater infrastructure.

7. We appreciate COVs interest in our product and their attempt to ascertain its affect on their wastewater treatment system and cooperated fully with them. However it appears in retrospect that it would have been more productive and time efficient to have commissioned a scientific study by a qualified testing institution, which COV is not.

City of Vancouver Response: The City's study was a basic study that raised several issues which deserve further, detailed study. The City agrees it would

have been helpful if this issue had been thoroughly studied before the product was introduced. Product testing is not the City's responsibility. However, protection of facilities, employees and receiving waters, is. The City has an excellent record in this regard.

8. We are in fact very disappointed that COV have chosen to recommend people not flush gDiapers into their system until more testing is done. The COV agrees that more study is needed and that their study is preliminary and inconclusive.

City of Vancouver Response: The City's recommendation of managing the product as a solid waste until more testing is performed is a prudent response and action. The City has a responsibility to protect our community's collection and treatment system and water resources. The City works with companies and citizens, providing education and information to help everyone be more environmentally responsible for a more sustainable Vancouver. The City makes no distinction or promotion of this or any other related products. The City is not telling consumers to avoid buying gDiapers. The City is saying that until the issues of how this product behaves within municipal collection and treatment systems and treatability have been examined in depth and demonstrated to be safe, our recommendation is that the product be managed as a solid waste, as with other disposable diapers, and not flushed down the toilet into the City's sewage collection and treatment system.

The City stands by its study, a basic look at the issue, and the study findings. The City agrees that additional in-depth research should be done to fully explore the collection and treatment system impacts and treatability issues raised.

9. We are a small company and believe that the previous testing we have done and the experience of more than 15 yrs of the products use shows that there is no danger to municipal systems.

City of Vancouver Response: Again, the City is not aware of any other studies performed that have specifically looked at the potential impacts within municipal collection and treatment systems as well as treatability within those systems. Representatives of gDiapers also indicated they were not aware of any studies looking at performance within municipal collection and treatment systems. Please note response to Part II, Key Points No. 2, above.

10. However we are committed to further testing, and the opportunity it affords to put to rest any and all concerns that COV have raised in their report.

City of Vancouver Response: We agree with this course of action and commend gDiapers manufacturer for the interest in further study.

11. The assessment of SAP is contradictory to the conclusions of our Cradle to Cradle Certification via McDonough Braungart Design Chemistry (mbdc.com). C2C

certification (recently upgraded to silver). The MBDC analysis is the most stringent ecological evaluation of compounds and materials in products currently available (and which includes the 4g per diaper of sodium polyacrylate, that COV makes much mention of). Every ingredient and manufacturing process in the make up of gDiaper flushables was evaluated against 19 human and environmental health criteria. SAP is shown to have about the same toxicity as table salt.

City of Vancouver Response: "Flushable" and "treatable" are not the same. Again, the City is not aware of any other studies that have specifically looked the potential impacts within municipal collection and treatment systems or treatability within those systems. Further, all MBDC Cradle to Cradle™ certifications carry the following disclaimer:

> "MBDC WARRANTS ONLY THAT ANY PRODUCT WHICH HAS BEEN CERTIFIED AS A TECHNICAL OR BIOLOGICAL NUTRIENT, SILVER, GOLD OR PLATINUM MEETS MBDC CRADLE TO CRADLE ™ CERTIFICATION PROGRAM CRITERIA FOR SUCH CERTIFICATION AND EXCEPT AS EXPRESSLY SET FORTH HEREIN:
>
> (A) MBDC MAKES NO WARRANTY, EXPRESS OR IMPLIED AS TO ANY PRODUCT WHICH HAS BEEN CERTIFIED UNDER THE MBDC CRADLE TO CRADLE ™ CERTIFICATION PROGRAM, **INCLUDING ANY WARRANTY AS TO MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE** AND MBDC HEREBY EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES; …"

As a result, product certification indicating components are non-toxic – not in dispute for the product tested here – cannot be presumed to address that product's treatability in a municipal wastewater system. Again, the City believes additional in-depth, qualified, independent research is needed to fully explore the collection and treatment system impacts and treatability issues raised.