PERFUME

AN INVESTIGATION OF CHEMICALS IN
36 EAUX DE TOILETTE AND EAUX DE PARFUM

REPORT 2005

l'eau de toxines

PHTHALATES SYNTHETIC MUSKS

AN INVESTIGATION OF CHEMICALS IN PERFUMES

GREENPEACE

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executive summary

The goal of this investigation was to quantify the use of two groups of chemicals – phthalates and synthetic musks – in a random selection of perfume brands. Greenpeace commissioned a laboratory to test 36 brands of eau de toilette and eau de parfum for levels of the two chemical groups. The results confirm that some synthetic musks, most notably the polycyclic musks galaxolide (HHCB) and tonalide (AHTN), and some phthalates, especially diethyl phthalate (DEP), are widely used by the perfume industry. This suggests that regular use of perfumes could substantially contribute to individuals' daily exposure to these chemicals, some of which have already been recorded as contaminants in blood and breast milk. Furthermore, there is increasing evidence of potential endocrine-disrupting properties for certain musk compounds. In this context, these results reinforce the need for legislation that will drive the replacement of hazardous substances with safer alternatives. The current development of new EU legislation on the manufacture and use of chemicals, known as REACH (Registration, Evaluation and Authorisation of Chemicals), provides the opportunity to set out requirements for such substitution as a vital contribution to protecting the public from exposure to hazardous chemicals.

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introduction

The widespread use of hazardous chemicals, combined with lack of adequate information and government control, has brought us to the chemical crisis we face today. In so many aspects of our daily lives, we use and release into the environment, often inadvertently, a wide range of chemicals. The hazards posed by the majority of these substances have never been properly assessed. At the same time, current legislation fails to control exposure even to chemicals that are known to possess hazardous properties, irrespective of whether safer alternatives already exist. As a consequence, from remote, inaccessible regions of the globe to the domestic environment, we find increasing evidence of chemical contamination.

Wild animals from the Arctic to the deep sea (Law *et al.* 2003, Lebeuf *et al.* 2004, Martin *et al.* 2004, Rayne *et al.* 2004, de Boer *et al.* 1998), rainwater (ter Schure and Larsson 2002, Peters 2003), dust in our homes (Rudel *et al.* 2003, Santillo *et al.* 2003a,b), and even our own bodies (WWF 2004, Peters 2004) have all been shown to be polluted with hazardous industrial chemicals. These chemicals are now so ubiquitous that a baby is exposed to industrial chemicals before he or she is even born (Dorey 2003). Chemicals that persist and build up in our bodies (bioaccumulate), that may be capable of causing cancers or other adverse health effects that may even interfere at a fundamental level with hormone communication systems and their role in development pose unknown consequences for our future (Darnerud 2003, Sharpe and Skakkebaek 2003, Dorey 2003).

But while the occurrence of hazardous man-made chemicals in the environment and in our bodies is increasingly widely documented, few of us are aware that many of these chemicals are ingredients in everyday consumer products. Chemicals used as flame-retardants in electronics products such as mobile phones, computers or televisions can contaminate a mother's milk (Lind *et al.* 2003, Kalantzi *et al.* 2004). Substances used in the plastic-coated prints sometimes found on children's pyjamas (Greenpeace 2004) are capable of interfering with development, hormone communication and immune system function in animals (Kergosien and Rice 1998, Chitra *et al.* 2002, Kumasaka *et al.* 2002, Adeoya-Osiguwa *et al.* 2003).

As part of an ongoing project investigating hazardous chemicals in consumer products, Greenpeace has commissioned an independent laboratory to analyse a wide range of products for potentially harmful substances. (see http://www.greenpeace.org/chemprodreport and http://www.greenpeace.org/addproducts) Greenpeace has also reviewed the actions and policies of a number of consumer goods manufacturers to evaluate their use of and measures to eliminate potentially hazardous chemicals from their products. The good news is that a growing number of companies are taking positive and proactive steps to replace such chemicals from a variety of consumer items, ranging from sports shoes and toys to mobile phones, textiles and body care products. The bad news is that many other companies continue to disregard mounting health and environmental concerns over the chemicals added to their products. Information on chemicals used in products and on companies' chemicals policies is published on the Greenpeace products database (available in English at http://www.greenpeace.org.uk/Products/Toxics/, in French at www.vigitox.org, in Dutch at www.lichaamzondergif.nl, and in Spanish at http://archivo.greenpeace.org/toxicos/html/home.html).

Elected members of the European Parliament and ministers of EU governments are currently debating legislation that has the potential to protect EU citizens from exposure to hazardous chemicals. For this legislation, known as REACH (Registration, Evaluation and Authorisation of Chemicals), to be truly effective, lawmakers must ensure that all companies are required to substitute hazardous chemicals by replacing them with safer alternatives wherever available.

CHEMICALS IN PERFUMES: A HEALTH AND ENVIRONMENTAL CONCERN

Two groups of hazardous or potentially hazardous chemicals commonly used in perfumes and other personal care products are phthalate esters, commonly known as phthalates, and synthetic (artificial or man-made) musks. As a consequence of the extensive and high-volume use of these chemicals in products, they have become widely distributed through both the natural and the urban environment. The ubiquitous presence of synthetic musks and phthalates in the environment and in consumer products, many of which are very slow to break down, results in continuous background exposures with unknown long-term consequences. At the same time, personal care products that we apply to our skin, including perfumes, provide a direct route of repeated exposure to relatively concentrated doses and may be expected to contribute substantially to our overall exposure to these chemicals.

Although data remain limited, there is evidence to suggest that the phthalates and synthetic musks in common use may present us with diverse health and environmental hazards. New evidence is emerging all the time. Further details of the properties and hazards of these chemicals are provided in the text boxes below.

DIETHYL PHTHALATE (DEP) AND OTHER PHTHALATE ESTERS

Diethyl phthalate (DEP) is one of many phthalate esters in common use. It is used in particular in a wide range of cosmetic and other personal care products, primarily as a solvent and vehicle for fragrances and other cosmetic ingredients and as an alcohol denaturant [making the alcohol unfit to drink] (SCCNFP 2003). Although DEP has generally been considered as having a low overall toxicity and does not appear to exhibit the same level of reproductive toxicity displayed by certain other phthalates (notably DEHP), newly emerging evidence raises significant concerns regarding its safety.

Given their widespread use in consumer goods, exposure to phthalates can occur through a variety of routes (Koo *et al.* 2002, Fromme *et al.* 2004). Since DEP is an ingredient of perfumes and other personal care products, it appears that inhalation may be a significant route of exposure (Adibi *et al.* 2003). Absorption through the skin is also likely to be a contributory factor.

Although DEP is rapidly metabolised in the human body to its monoester form (MEP) and does not appear to accumulate in tissues, it is clear that when applied to the skin DEP rapidly penetrates it and becomes widely distributed around the body following each exposure (WHO 2003). MEP has been reported at up to 30 times higher concentrations in human urine than metabolites of any other phthalate ester (Duty *et al.* 2003). One study (Silva *et al.* 2004) has recently shown that, whereas levels of certain other phthalate metabolites excreted in the urine are generally higher in children than in adults, levels of MEP are commonly twice as high in young adults as they are in children, with the highest levels of all in women, possibly reflecting differences in frequency of use of personal care products, such as hair care products, cosmetics and perfumes.

The long-term effects of such repeated direct exposure to DEP are not well understood. However, some recent evidence indicates that changes to the DNA of sperm cells are more prevalent in individuals who also show high levels of MEP in their urine (Duty *et al.* 2003); further studies are necessary to determine if there is a causal relationship. More recently still, research has identified a possible link between exposure to two phthalate metabolites, namely MEP and MBP (monobutyl phthalate), measured in urine samples, and restricted lung function in adult men (Hoppin *et al.* 2004).

A number of other phthalates identified in the perfume samples, albeit at far lower levels than DEP, are also of toxicological concern. Of particular note are dibutyl phthalate (DBP) and diethylhexyl phthalate (DEHP), both of which are classified in the EU as toxic to reproduction (Category 2) (EU 2003).

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SYNTHETIC MUSKS

Synthetic musks are man-made aromatic compounds that are used in place of more expensive natural musks. They are added to many everyday products, including laundry detergents, air fresheners, hand creams, soaps and perfumes (OSPAR 2004).

The term synthetic musks encompasses three broad chemical groups: nitromusks, polycyclic musks and macrocyclic musks. Due to toxicological concerns, nitromusk production has been in decline in Europe for a number of years. Only two nitromusks are of importance today: musk xylene (MX) and musk ketone (MK). These, along with two polycyclic musks, galaxolide (HHCB) and tonalide (AHTN) account for 95% of the European market for synthetic musks (OSPAR 2004).

Synthetic musks are environmentally persistent chemicals and, as a consequence of this and their extensive use in products, have become widely distributed in the environment, especially in aquatic and marine systems (Eschke 2004, Leonards and de Boer 2004, Bester *et al.* 1998) but also in the atmosphere (Peters 2003) and inside buildings (Kallenborn and Gatermann 2004).

A study commissioned by Greenpeace Netherlands of chemicals in rainwater within the Netherlands found synthetic musk compounds in virtually all rainwater samples (Peters 2003). While HHCB was found to be distributed fairly evenly, there was a clear peak in levels of AHTN in the centre of the country. This peak coincided with the location of a chemical company that produces synthetic musk compounds. Significantly, the nitromusk musk ambrette (MA), which has been banned in the EU since 1995, was found at 34% of the rainwater collection points, suggesting long-term environmental persistence.

Synthetic musks can concentrate in living tissues; indeed, musks used in perfumes have also been found contaminating human blood and breast milk (Rimkus and Wolf 1996, Peters 2004). There is increasing evidence emerging that some nitromusks and polycyclic musks, including those commonly used in perfumes, may be capable (either as parent compounds or as metabolites) of interfering with hormone communication systems in fish (Schreurs *et al.* 2004), amphibians (Dietrich and Hitzfeld 2004) and mammals (Bitsch *et al.* 2002, Schreurs *et al.* 2002), and may exacerbate the effects of exposure to other toxic chemicals (Smital *et al.* 2004).

Although the oestrogenic activity exhibited by HHCB and AHTN in mammals is relatively weak, anti-oestrogenic effects have been observed for the same compounds at concentrations more than 100 times lower (Schreurs *et al.* 2002). Statistical associations have been reported between MX and MK levels in the blood and the occurrence of certain gynaecological conditions in women (Eisenhardt *et al.* 2001), though a causal relationship has not been established.

Perfumes may bring us pleasure, but we could enjoy them even more if we knew they were free of substances that could build up in the environment and in our bodies and even have the potential to affect our health. Consumers wishing to avoid these substances face a difficult task, since manufacturers rarely label phthalates and synthetic musks on the packaging.

II ANALYSIS OF PERFUMES

Between 2003 and 2004 Greenpeace commissioned the quantitative analysis of a random selection of 36 brands of eau de toilette and eau de parfum for phthalates, polycyclic musks and nitromusks. The independent Netherlands laboratory, TNO Environment and Geosciences, conducted the analyses (Peters, 2005) (http://www.greenpeace.org/tnoperfumereport). Detailed results of the analysis are shown in the annex of this report.

The results show that phthalates and synthetic musks are present in virtually every perfume brand that was tested.

All but one sample contained measurable levels of phthalates, with amounts varying enormously between brands. Only one had no detectable phthalate content. Several others had low levels of total phthalates, below 10 mg/kg (0.001%). By contrast, the sample with the highest level of phthalates contained over 22 000 mg/kg (2.2% of total sample by weight).

The most prevalent phthalate was diethyl phthalate (DEP), found in 34 out of the 36 perfumes tested and with widely varying levels. Only Gloria Vanderbilt's Vanderbilt and Bogner's High Speed contained no detectable levels of this phthalate. The highest levels of DEP were found in Calvin Klein's Eternity for Women (22 299 mg/kg, or 2.2% by weight), Melvita's Iris Blue (11 189 mg/kg, or 1.1%) and Jean-Paul Gaultier's Le Mâle (9 884 mg/kg, or just under 1%).

The perfumes tested also showed wide variations in the quantities of synthetic musks that they contained. Total levels of nitromusks and polycyclic musks were lowest in Puma's Puma Jamaica Man (0.1 mg/kg), Alqvimia's Aqua Natural (0.5 mg/kg), Naomi Campbell's Sunset (1.8 mg/kg) and Christian Dior's Pure Poison (2 mg/kg). Highest total quantities of these synthetic musks were found in Cartier's Le Baiser Du Dragon (45 048 mg/kg, or 4.5% by weight) and Gaultier's Le Mâle (64 428 mg/kg, or 6.4%), and, with a remarkable 94 069 mg/kg (9.4%), The Body Shop's White Musk.

Nitromusks were found in a limited number of perfumes and mainly at low or non-detectable levels, with the exception of Chanel's No. 5, which contained 4 670.4 mg/kg (0.46%) of musk ketone (MK). Polycyclic musks, especially galaxolide (HHCB) and tonalide (AHTN), were found in almost all perfumes, but again levels varied enormously. Levels of HHCB varied from highs of 77 848 mg/kg (7.8% by weight) in The Body Shop's White Musk, 44 776 mg/kg (4.5%) in Cartier's Le Baiser Du Dragon and 37 644 mg/kg (3.8%) in Jean-Paul Gaultier's Le Mâle to values of less than 1 mg/kg in some other products. 5 of the perfume products were analysed for a fewer number of synthetic musks than the other brands and could conceivably contain a higher total of synthetic musks than that reported.

Reasons for the wide disparity in levels of phthalates (below detection to 2.2% by weight) and synthetic musks (below detection to 9.4% by weight) are currently unknown. While the absence of these chemicals at detectable limits in some brands suggests that it may be possible to manufacture and successfully market perfumes without their deliberate use, it is not possible from the results of this investigation to determine which other chemical ingredients may be used instead. Given the legitimate concerns surrounding the continued use of phthalates and synthetic musk compounds, however, further research into this issue is urgently required.

One possible explanation for the apparent absence of nitromusk and polycyclic musk compounds in some perfumes is the increasing interest within the fragrance industry in the use of macrocyclic musks in place of polycyclic musks and nitromusks. Very little information is available on their scale of use or their potential hazards to human health or the environment. Greenpeace also commissioned TNO to carry out a qualitative analysis of macrocyclic musks in 29 of the perfumes tested. 21 of these tested positive for macrocyclic musks. The analyses conducted in the TNO study provide an initial indication of their widespread use, illustrating the need for further research.

III THE LIMITS OF EXISTING LEGISLATION

Existing EU legislation provides us only with partial protection from the chemicals used in cosmetics, including perfume products. The EU Cosmetics Directive (76/768/EEC) restricts the use in cosmetic products of chemicals that are classified as carcinogenic, mutagenic or toxic to reproduction (CMR). This restriction already prohibits the use of at least one nitromusk, musk ambrette. However, the same Directive:

- does not prevent the use of chemicals of equivalent concern, such as endocrine disruptors;
- fails to address exposure arising from the environmental distribution of the chemicals used in the manufacture of cosmetic products, or from the use and disposal of these products;
- lacks any authorisation procedure that would require manufacturers to adopt a policy of precaution or to seek systematic solutions to phase out and replace undesirable chemical groups.

Only a strong and overarching precautionary approach to chemical legislation will address such regulatory failings and lead industry to promote innovation of safer substitutes and to phase out chemicals of concern.

IV ACCEPT THE RISKS OR TAKE PRECAUTIONS?

This study confirms the widespread use of phthalates and synthetic musk compounds in perfumes and the fact that these potentially hazardous ingredients may constitute a significant percentage of the overall weight of the product.

The definitive health risks of any particular chemical substance are always difficult, if not impossible, to quantify, and though they may take many years to complete, assessments are often highly subjective or even inconclusive. The assumptions used and judgements made in reaching conclusions regarding risks to the environment or human health are rarely communicated beyond technical papers, despite the importance of these aspects to the interpretation of conclusions drawn and the degree of uncertainty that underlies them. Moreover, risk assessment starts from the position that some level of exposure to a chemical, even one showing intrinsically hazardous properties, is ultimately ‘acceptable’ and can be managed.

Given the added complexities resulting from the fact that we are exposed not to individual chemicals, but chemical mixtures and that there are commonly many different sources of each chemical in our daily lives, it is clear that traditional narrow risk assessment techniques are unlikely to provide adequate protection. A more precautionary approach to the evaluation and control of chemicals is urgently required.

Recent opinions adopted by the EU Scientific Committee on Cosmetic Products and Non-Food Products, SCCNFP (reorganised into the Scientific Committee on Consumer Products in 2004), concerning HHCB and AHTN (SCCNFP 2002 a, b), illustrate the influence of underlying assumptions when determining "acceptable risk". The Committee advises that HHCB can be used as a fragrance ingredient in cosmetics without restrictions and that AHTN may be similarly used up to a maximum of 12% of the fragrance compound (as opposed to 12% of the final product), and base their recommendation on estimated 'margins of safety'. The calculation of these margins of safety depends heavily on the choice of representative values for exposure, skin absorption and toxicity.

In this instance, to determine the margin of safety for HHCB, the Committee assumed a skin absorption of 0.1% of applied dose and a typical concentration of the chemical in a perfume product (eau de toilette) of 2.4%. A much higher estimate of absorbed dose (5.1%) was rejected on the basis that the study from which it was derived did not meet the Committee's 'notes of guidance' and that it applied the dose in pure ethanol, considered unrepresentative of commercial products. But given that true perfumes (including eaux de parfum) can contain as high as 75% ethanol by weight (Bearling 1999), this study may have greater relevance. The results from the TNO analyses moreover show that even in comparably weaker eaux de toilette formulations, HHCB levels can exceed the Committee's assumption of a 2.4% concentration (in 5 of 36 products analysed by TNO). Applying these relatively 'worst case' estimates for absorption and concentration, margins of safety could have been reduced by a factor of at least 100.

For AHTN, the Committee similarly assumed a typical product concentration value of 0.96% and again rejected the consideration of a higher measure of absorbed dose in its calculations to determine a margin of safety. The results of the TNO analysis show how these values can be exceeded in 2 of the 36 samples tested. Additionally, the Committee itself cautions that its opinions on these chemicals do not take account of additional consumer exposure from a diversity of other sources (SCCNFP 2002 a, b). Cosmetics are not the only sources of human exposure to musks; air fresheners, soaps and laundry detergents may all contain musks.

It is unclear from the Committee's deliberations precisely how no-observed-adverse-effect levels of 50 mg/kg and 5 mg/kg for HHCB and AHTN respectively were derived, or whether these values include consideration of potential endocrine-disrupting properties or synergistic effects with other toxic chemicals.

In any event, it is certain that new evidence of the environmental and health effects of these chemicals emerging since 2002 could not have been considered, though it may well be of relevance for the margin of safety calculated.

the way forward

This research confirms the presence of potentially hazardous chemicals in eau de toilette and eau de parfum products. The quantities of the chemical substances vary widely between individual products and there are many gaps in the regulation of their use.

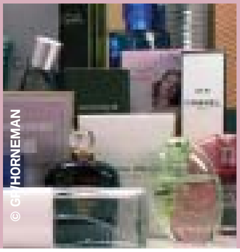
REACH, the proposed EU chemicals reform, has the potential to set in motion an authorisation process that would require the phase out and substitution of hazardous chemicals, in particular 'substances of high concern' which display properties that may harm our health and environment. This includes chemicals that are persistent, bioaccumulative and toxic (PBT) and those that are very persistent and very bioaccumulative (vPvB), chemicals that have the potential to cause cancer, reproductive damage or give rise to genetic mutations (CMR) and chemicals that can affect the hormonal system (endocrine disruptors). While it remains to be seen whether phthalates and synthetic musks will ultimately be officially identified as "chemicals of very high concern" under REACH, the emerging evidence of hazardous properties outlined above clearly gives grounds for their consideration.

The REACH proposal, published by the EU Commission in October 2003, has suffered from intensive lobbying by industry. The proposed regulation contains a loophole that would authorise the continued use of a 'substance of very high concern' even if a safer alternative were available.

Greenpeace believes that for REACH to protect us from exposure to harmful chemicals, an authorisation for the use of 'chemicals of very high concern' should be refused unless no safer alternatives are available and the use is essential to society. This is the principle of substitution.

Some companies are responding to increasing consumer awareness of synthetic chemicals in products and are setting in place policies to phase out and replace certain harmful chemicals. Such companies prove that an innovative approach, leading to a new generation of safer products, can equally lead to commercial success. Perfume companies should follow their lead. However, voluntary agreements are not enough to drive across the board innovation and green solutions. REACH needs to provide the legally binding structures to implement a chemicals policy based on precaution and driving innovation.

The challenge now is for elected representatives and government ministers to strengthen REACH and thus to protect us from hazardous chemicals in everyday life.



annex 1

PHTHALATES ABBR.:
- DMP DI-METHYL PHTHALATE
- DEP DI-ETHYL PHTHALATE
- DIBP DI-ISO-BUTYL PHTHALATE
- DBP DI-N-BUTYL PHTHALATE
- BBP BENZYLBUTYL PHTHALATE
- DCHP DI-CYCLOHEXYL PHTHALATE
- DEHP DI-(2-ETHYLHEXYL) PHTHALATE
- DOP DI-N-OCTYL PHTHALATE
- DINP DI-ISO-NONYL PHTHALATE
- DIDP DI-ISO-DECYL PHTHALATE

ANNEX 1 / TABLE 1: ANALYSIS OF PHTHALATES ALL VALUES MG/KG

PRODUCT	EDT/EDP	DMP	DEP	DIBP	DBP	BBP	DCHP	DEHP	DOP	DINP	DIDP	SUM OF PHTHALATES MEASURED
Adidas, Floral Dream	edt	0.3	1 301	5.8	<0.1	<0.1	<0.1	<1	<0.1	<1	<1	1307.1
Alqvimia, Agua Natural	edt	1.7	1 667	0.8	6.0	110	<0.1	<1	<0.1	<1	<1	1785.5
Armani, She	edp	1.3	1383	3.0	0.8	<0.1	<0.1	<1	<0.1	<1	<1	1388.1
Bogner, High Speed	edt	<0.1	<1	<0.1	<0.1	0.1	<0.1	<1	<0.1	<1	37	37.1
Bvlgari, Blv Notte pour Homme	edt	<0.1	3902	3.1	<0.1	<0.1	2.9	<1	<0.1	<1	<1	3908
Calvin Klein, CK One	edt	<1	1073	<1	<1	<1	<1	76	<1	<1	<1	1 149
Calvin Klein, Eternity for Men	edt	<0.1	8232	2.9	0.9	<0.1	<0.1	1.2	<0.1	<1	<1	8237
Calvin Klein, Eternity for Women	edt	<1	22299	38	14	<1	<1	88	<1	<1	<1	22439
Cartier, Le Baiser Du Dragon	edp	<0.1	4533	<0.1	<0.1	0.3	<0.1	<1	<0.1	26	<1	4559.3
Chanel, Chance	edt	<0.1	19	<0.1	2.1	0.9	<0.1	<1	<0.1	<1	<1	22
Chanel, No. 5	edp	<1	325	<1	<1	<1	<1	20	<1	<1	<1	345
Coty, Celine Dion	edt	1.7	4072	3.5	3.1	<0.1	<0.1	<1	<0.1	<1	10	4090.3
Dior, Poison	edt	<1	5675	33	14	<1	<1	167	<1	<1	<1	5889
Dior, Pure Poison	edp	<0.1	29	3.9	2.5	<0.1	<0.1	<1	<0.1	<1	<1	35.4
Etienne Aigner, Aigner In Leather	edt	0.8	1909	3.8	0.7	<0.1	<0.1	12	<0.1	<1	<1	1926.3
FCUK, Him	edt	<0.1	4.8	<0.1	1.1	<0.1	<0.1	<1	<0.1	<1	1.5	7.5
Fiorucci, Fiorucci Loves You	edt	<0.1	2190	0.2	0.2	0.3	<0.1	<1	<0.1	<1	<1	2190.7
Gloria Vanderbilt, Vanderbilt	edt	<0.1	<1	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<1	<1	*
Gucci, Envy Me	edt	<0.1	25	4.9	<0.1	<0.1	<0.1	2.3	<0.1	<1	<1	32.2
Hugo Boss, Boss in Motion	edt	1.9	2.3	1.7	0.1	<0.1	<0.1	<1	<0.1	<1	<1	6.0
Isabella Rossellini, My Manifesto	edp	0.6	1553	8.7	<0.1	<0.1	<0.1	<1	<0.1	<1	<1	1562.3
Jean-Paul Gaultier, Classique	edt	<1	785	<1	1	<1	<1	1	<1	<1	<1	787
Jean-Paul Gaultier, Le Mâle	edt	0.4	9884	<0.1	<0.1	1.0	<0.1	<1	<0.1	<1	<1	9885.4
Joop!, Nightflight	edt	<0.1	3988	0.2	<0.1	<0.1	<0.1	1.7	<0.1	<1	<1	3989.9
Lancôme, Miracle So Magic	edp	<0.1	0.4	5.2	<0.1	<0.1	<0.1	<1	<0.1	<1	<1	5.6
Melvita, Iris Blue	edt	<0.1	11189	<0.1	0.7	77	<0.1	4.9	<0.1	<1	<1	11271.7
Mexx, Waterlove Man	edt	<0.1	18	<0.1	0.4	<0.1	<0.1	6.0	<0.1	<1	11	35.4
Naomi Campbell, Sunset	edt	1.1	1.2	<0.1	<0.1	0.1	<0.1	<1	<0.1	<1	2.1	4.5
Paco Rabanne, XS Excess Pour Homme	edt	0.3	2822	4.9	0.2	<0.1	<0.1	7.5	<0.1	<1	<1	2834.9
Puma, Puma Jamaica Man	edt	<0.1	37	5.5	2.9	<0.1	<0.1	25	<0.1	<1	<1	70.4
Puma, Puma Woman	edt	<0.1	27	1.9	1.8	<0.1	<0.1	<1	<0.1	<1	<1	30.7
Ralph Lauren, Polo Blue	edt	1.2	5338	<0.1	0.2	<0.1	<0.1	<1	<0.1	<1	<1	5339.4
The Body Shop, White Musk	edp	2982	37	<0.1	<0.1	0.6	<0.1	<1	<0.1	<1	<1	3019.6
Tommy Hilfiger, True Star	edp	1.9	225	<0.1	0.2	<0.1	<0.1	<1	<0.1	<1	<1	227.1
Van Gils, Van Gils	edt	<0.1	5637	5.3	1.5	<0.1	<0.1	1.1	<0.1	<1	<1	5644.9
Yves Saint Laurent, Cinema	edp	0.7	102	<0.1	<0.1	<0.1	<0.1	<1	<0.1	<1	<1	102.7

* ALL MEASURED PHTHALATES WERE BELOW DETECTION LIMITS EDT EAU DE TOILETTE EDP EAU DE PARFUM

ANNEX 2 / TABLE 2: ANALYSIS OF NITROMUSKS AND POLYCYCLIC MUSKS ALL VALUES MG/KG

PRODUCT	EDT/EDP	ADBI	AHMI	AHTN	ATTI	DPMI	HHCB	MA	MK	MM	MT	MX	SUM OF NITROMUSKS AND POLYCYCLIC MUSKS MEASURED
Adidas, Floral Dream	edt	<0.1	<0.1	18	<0.1	3.3	73	<0.1	<0.1	<0.1	0.7	<0.1	95
Alqvimia, Agua Natural	edt	<0.1	<0.1	0.1	<0.1	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	0.5
Armani, She	edp	2.4	<0.1	53	<0.1	3.6	8972	<0.1	<0.1	<0.1	<0.1	<0.1	9031
Bogner, High Speed	edt	<0.1	<0.1	0.3	<0.1	588	5.9	<0.1	0.7	<0.1	<0.1	0.1	595
Bvlgari, Blv Notte pour Homme	edt	20	3.1	1751	<0.1	698	26350	<0.1	<0.1	<0.1	<0.1	<0.1	28822.1
Calvin Klein, CK One	edt	10	---	1132	30	<0.5	2709	<0.5	<0.5	<0.5	<0.5	<0.5	3881
Calvin Klein, Eternity for Men	edt	9.2	11	7273	<0.1	<0.1	19970	<0.1	<0.1	<0.1	<0.1	<0.1	27263.2
Calvin Klein, Eternity for Women	edt	---	---	50	---	---	7992	<0.5	<0.5	<0.5	<0.5	<0.5	8042
Cartier, Le Baiser Du Dragon	edp	50	<0.1	222	<0.1	<0.1	44776	<0.1	0.4	<0.1	<0.1	<0.1	45048.4
Chanel, Chance	edt	<0.1	<0.1	17	<0.1	<0.1	18	<0.1	<0.1	<0.1	<0.1	<0.1	35
Chanel, No. 5	edp	---	---	3.2	---	---	73	<0.5	4592	<0.5	<0.5	2.2	4670.4
Coty, Celine Dion	edt	7.9	1.1	111	<0.1	164	18463	<0.1	<0.1	<0.1	1.1	<0.1	18748.1
Dior, Poison	edt	---	---	20	---	---	6248	<0.5	<0.5	<0.5	<0.5	<0.5	6268
Dior, Pure Poison	edp	0.2	<0.1	<0.1	<0.1	<0.1	1.4	<0.1	<0.1	<0.1	<0.1	0.4	2
Etienne Aigner, Aigner In Leather	edt	<0.1	<0.1	32	0.1	232	20	<0.1	0.5	<0.1	<0.1	<0.1	284.6
FCUK, Him	edt	17	2.8	73	<0.1	278	19476	<0.1	<0.1	<0.1	<0.1	<0.1	19846.8
Fiorucci, Fiorucci Loves You	edt	<0.1	<0.1	0.9	<0.1	<0.1	6.3	<0.1	<0.1	<0.1	<0.1	0.2	7.4
Gloria Vanderbilt, Vanderbilt	edt	<0.1	<0.1	0.1	<0.1	0.6	75	<0.1	<0.1	<0.1	<0.1	<0.1	75.7
Gucci, Envy Me	edt	<0.1	<0.1	<0.1	<0.1	192	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	192.4
Hugo Boss, Boss in Motion	edt	<0.1	<0.1	1.3	<0.1	271	7.2	<0.1	<0.1	<0.1	<0.1	0.1	279.6
Isabella Rossellini, My Manifesto	edp	<0.1	<0.1	2.8	<0.1	2.0	9.0	<0.1	<0.1	<0.1	0.3	<0.1	14.1
Jean-Paul Gaultier, Classique	edt	21	---	60	<0.5	<0.5	4 902	<0.5	<0.5	<0.5	<0.5	<0.5	4983
Jean-Paul Gaultier, Le Mâle	edt	30	42	26200	512	<0.1	37644	<0.1	<0.1	<0.1	<0.1	<0.1	64428
Joop!, Nightflight	edt	<0.1	<0.1	1.2	0.3	<0.1	8.8	<0.1	<0.1	<0.1	<0.1	0.2	10.5
Lancôme, Miracle So Magic	edp	<0.1	<0.1	0.7	<0.1	<0.1	2.0	<0.1	<0.1	<0.1	0.3	<0.1	3
Melvita, Iris Blue	edt	<0.1	<0.1	0.7	<0.1	<0.1	44	<0.1	<0.1	<0.1	<0.1	<0.1	45
Mexx, Waterlove Man	edt	<0.1	<0.1	0.3	0.5	150	0.5	<0.1	<0.1	<0.1	0.4	0.1	151.8
Naomi Campbell, Sunset	edt	0.1	<0.1	0.4	<0.1	<0.1	1.3	<0.1	<0.1	<0.1	<0.1	<0.1	1.8
Paco Rabanne, XS Excess Pour Homme	edt	8.3	15	8507	1.7	170	0.8	<0.1	11	15	<0.1	15	8743.8
Puma, Puma Jamaica Man	edt	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Puma, Puma Woman	edt	<0.1	<0.1	1.2	<0.1	<0.1	1.4	<0.1	<0.1	<0.1	<0.1	<0.1	2.6
Ralph Lauren, Polo Blue	edt	5.5	9.2	7827	<0.1	59	21054	<0.1	0.1	<0.1	<0.1	<0.1	28954.8
The Body Shop, White Musk	edp	133	28	16060	<0.1	<0.1	77848	<0.1	<0.1	<0.1	<0.1	<0.1	94069
Tommy Hilfiger, True Star	edp	23	3.7	110	19	5.3	25630	<0.1	<0.1	<0.1	0.5	<0.1	25791.5
Van Gils, Van Gils	edt	17	7.4	383	<0.1	6.0	1627	<0.1	<0.1	<0.1	<0.1	<0.1	2040.4
Yves Saint Laurent, Cinema	edp	8.3	2.0	88	<0.1	<0.1	17232	<0.1	0.2	<0.1	<0.1	<0.1	17330.5

- PRODUCT WAS NOT ANALYSED FOR THIS SUBSTANCE EDT EAU DE TOILETTE EDP EAU DE PARFUM

annex 2

NITROMUSKS ABBR.:
MA MUSK AMBRETTE 2,6-DINITRO -3-METHOXY-4-T-BUTYL-TOLUENE
MK MUSK KETONE 4,6-DINITRO -2-ACETYL-5-T-BUTYL-TOLUENE
MM MUSK MOSKENE 4,6-DINITRO -1,1,3,3,5-PENTAMETHYL-INDANE
MT MUSK TIBETENE 2,6-DINITRO-3, 4,5-TRIMETHYL-1-T-BUTYL-BENZENE
MX MUSK XYLENE 2,4,6-TRINITRO -5-T-BUTYL-XYLENE.

POLYCYCLIC MUSKS ABBR.:
DPMI CASHMERON 6,7-DIHYDRO -1,1,2,3,3-PENTAMETHYL-4(5H) -INDANONE
ADBI CELESTOLIDE, CRYSOLIDE 4-ACETYL-1,1-DIMETHYL-6-T -BUTYLDIHYDRO-INDENE
HHCB GALAXOLIDE, MUSK GX, ABBALIDE, MUSK 50, PEARLIDE 1,3,4,6,7, 8-HEXAHYDRO- 4,6,6,7,8, 8-HEXAMETHYLCYCLOPENTA -2-BENZOPYRAN
AHMI PHANTOLIDE 5-ACETYL -1,1,2,3,3,6-HEXAMETHYL-INDANE
AHTN TONALIDE, FIXOLIDE, TETRALIDE 7-ACETYL-1,1,3,4,4,6-HEXAMETHYL -1,2,3,4-TETRAHYDRONAPHTHALENE
ATTI TRASEOLIDE 5-ACETYL-1,1,2,6 -TETRAMETHYL-3-ISOPROPYL-INDANE

annex 3

MACROCYCLIC MUSKS:
MUSCONE 3-METHYL-CYCLOPENTADECANONE
EXALTOLIDE CYCLOPENTADECANOLIDE, PENTALIDE, THIBETOLIDE OXACYCLOHEXADECAN-2-ONE
AMBRETTOLIDE Z-OXACYCLO-HEPTADEC-8-EN-2-ONE
ETHYLENE BRASSYLATE ASTRATONE, MUSK T. 1,4-DIOXACYCLOHEPTADECANE-5,17-DIONE
CIVETONE Z-9-CYCLOHEPTADECEN-1-ONE

ANNEX 3 / TABLE 3: ANALYSIS OF MACROCYCLIC MUSKS

PRODUCT	MUSCONE	CIVETONE	AMBRETTOLIDE	EXALTOLIDE	ETHYLENE BRASSYLATE	MUSCONATE
Adidas, Floral Dream	n	n	n	n	n	n
Alqvimia, Agua Natural	n	n	n	n	n	n
Armani, She	n	n	n	y	y	n
Bogner, High Speed	n	n	y	y	y	n
Bvlgari, Blv Notte pour Homme	n	n	n	n	y	n
Calvin Klein, CK One	-	-	-	-	-	-
Calvin Klein, Eternity for Men	n	n	n	n	n	n
Calvin Klein, Eternity for Women	-	-	-	-	-	-
Cartier, Le Baiser Du Dragon	n	n	n	y	y	n
Chanel, Chance	n	n	n	n	y	n
Chanel, No. 5	-	-	-	-	-	-
Coty, Celine Dion	y	n	n	n	n	n
Dior, Poison	-	-	-	-	-	-
Dior, Pure Poison	n	n	n	y	y	n
Etienne Aigner, Aigner In Leather	n	y	y	n	n	n
FCUK, Him	n	n	n	y	y	n
Fiorucci, Fiorucci Loves You	n	n	n	y	y	n
Gloria Vanderbilt, Vanderbilt	n	n	n	n	n	n
Gucci, Envy Me	n	n	n	n	y	n
Hugo Boss, Boss in Motion	n	n	y	y	y	y
Isabella Rossellini, My Manifesto	n	n	n	n	y	n
Jean-Paul Gaultier, Classique	-	-	-	-	-	-
Jean-Paul Gaultier, Le Mâle	n	n	n	n	n	n
Joop!, Nightflight	n	n	n	n	n	n
Lancôme, Miracle So Magic	n	n	n	y	y	n
Melvita, Iris Blue	n	n	n	n	n	n
Mexx, Waterlove Man	n	y	y	y	n	n
Naomi Campbell, Sunset	n	n	n	y	y	n
Paco Rabanne, XS Excess Pour Homme	n	y	n	n	n	n
Puma, Puma Jamaica Man	-	-	-	-	-	-
Puma, Puma Woman	-	-	-	-	-	-
Ralph Lauren, Polo Blue	n	n	n	y	n	n
The Body Shop, White Musk	n	n	n	n	y	n
Tommy Hilfiger, True Star	n	n	y	n	n	n
Van Gils, Van Gils	n	n	n	n	n	n
Yves Saint Laurent, Cinema	n	n	n	n	y	n

- PRODUCT WAS NOT ANALYSED FOR THIS SUBSTANCE, Y YES, SUBSTANCE DETECTED, N NO, SUBSTANCE, NOT DETECTED

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perfume

AN INVESTIGATION OF CHEMICALS IN
36 EAUX DE TOILETTE AND EAUX DE PARFUM

GREENPEACE

greenpeace international
Ottho Heldringstraat 5, 1066 AZ Amsterdam, Netherlands
t +31 20 514 8150 f +31 20 514 8151
www.greenpeace.org