Proposal to Control Volatile Organic Compounds (VOC) in Fountain Solutions and Printing Machine Cleansing Agents

PURPOSE

This consultation paper sets out a proposal to control the volatile organic compounds (VOC) content of fountain solutions and printing machine cleansing agents that are imported to or manufactured in Hong Kong with a view to improving air quality. We would like to have your views on the proposal on or before **30 April 2016**.

BACKGROUND

2. VOC are organic chemicals that would evaporate at room temperature. Some of them are toxic while most of them could contribute to the formation of photochemical smog, which is a key regional air pollution problem in the Pearl River Delta (PRD). Photochemical smog leads to high levels of ozone and fine particulates in Hong Kong particularly when the prevailing wind is from inland and the sunshine is strong. To tackle the photochemical smog problem, we are making concerted effort with Guangdong to reduce VOC emissions in the PRD region (including Hong Kong). Specific emission reduction targets[1] for VOC have been set for 2015 and 2020.

3. In Hong Kong, non-combustion (mainly VOC containing products such as paints, printing inks, consumer products, adhesives and sealants), road transport (mainly petrol and liquefied petroleum gas (LPG) vehicles) and navigation (mainly small boats) are the major man-made VOC sources. They accounted for 58%, 23% and 11% respectively of the 29,420 tonnes of VOC emissions in 2013. The Government started regulating the VOC contents of these products in 2007 via the Air Pollution Control (Volatile Organic Compounds) Regulation[2] (VOC Regulation) by banning the import and local manufacture of these products (except products manufactured locally solely for export) if their VOC contents exceed the relevant statutory limits. At present, 170 types of products are under the control of the VOC Regulation. The VOC Regulation also controls the VOC emissions from lithographic heatset web printing machines. Between 2007 and 2013, the VOC Regulation and other control measures (such as the

[1] In 2012, the governments of Hong Kong and Guangdong have endorsed an emission reduction plan for the PRD Region up to 2020 which set the reduction targets for four major air pollutants including VOC. Hong Kong's VOC reduction targets are to reduce its emission by 5% by 2015 and 15% by 2020 with 2010 as the base year.

[2] Reference about the VOC Regulation can be found at following website: http://www.epd.gov.hk/epd/english/environmentinhk/air/prob_solutions/voc_reg.html

adoption of tighter vehicle emission standards and the strengthened emission control programme for petrol and LPG vehicles) reduced the total VOC emissions in Hong Kong by 31%, from 42,810 tonnes to 29,420 tonnes.

4. With the implementation of the VOC Regulation, the VOC emissions from VOC containing products had been reduced by 42% from 26,630 tonnes in 2007 to 15,520 tonnes in 2013. To further reduce VOC emissions for better air quality, we are now exploring additional VOC control measures targeting at non-combustion sources, which are the largest man-made VOC emission source. Among these sources, the printing sector could contribute more towards VOC emission reduction by introducing an enhanced VOC control programme targeting at fountain solutions and printing machine cleansing agents. Fountain solution is the solution used in lithographic printing which is applied to the image plate to maintain the hydrophilic properties of the non-image areas. It is primarily water containing an etchant, a hydrophilic gum and/or a dampening aid. Printing machine cleansing agent is a liquid used to remove printing ink and debris from the surfaces of the printing machine and its parts, such as blanket and roller.

THE STUDY

5. The average VOC content of conventional fountain solutions used for printing is 92 grams per litre (g/l). Organic solvents with average VOC content of 780 g/l are used for cleaning printing machines. The use of fountain solutions and printing machine cleansing agents with lower VOC contents can further reduce VOC emissions from the printing industry. In 2012, we commissioned the Hong Kong Productivity Council (HKPC) to identify feasible VOC reduction measures for the printing industry in collaboration with the printing trade. A Working Group on Reducing VOC – Printing Industry[3] was formed to oversee the feasibility study. Having reviewed the technologies available, HKPC tested five options from September 2012 to February 2013. The tests confirmed the satisfactory performance of low VOC fountain solutions and printing machine cleansing agents with VOC content below 80 grams per litre (g/l) and 500 g/l respectively in local factories, many of which are small in scale. The additional cost is less than 0.4 cent per sheet for printing 5,000 standard printing plates (paper size in 28 inch x 40 inch). The total printing cost depends on a number of factors including rent, equipment, labour, paper quality, quantity and size, colour, graphic design and treatment. The cost of fountain solution and printing machine cleansing agent accounts for a very small portion of the total production cost. We

[3] The Working Group on Reducing VOC – Printing Industry comprises representatives of the Hong Kong Printers Association, the Graphic Arts Association of Hong Kong and the Environmental Protection Department.

estimated that the cost increase is less than 1% of the total production cost. The tests and findings of the feasibility study are summarized in ***Annex 1***. The Working Group endorsed the findings in November 2014.

SUPPLY OF LOW VOC FOUNTAIN SOLUTIONS AND PRINTING MACHINE CLEANSING AGENTS

6. Subsequent to the study, we have consulted several major suppliers of fountain solutions and printing machine cleansing agents regarding the supply of fountain solutions of VOC content below 80 g/l and printing machine cleansing agents of VOC content below 500 g/l to the local market. A survey has also been done to check the availability of these products in the local market. The outcomes of the consultation and the survey confirmed that the products are already available on the local market and their supply will not be a problem if the printing industry is mandated to use them.

THE PROPOSAL

Control Framework

7. We propose to extend the current statutory control to fountain solutions and printing machine cleansing agents by amending the VOC Regulation. In gist, fountain solutions and printing machine cleansing agents with VOC content exceeding the stipulated statutory limits cannot be imported to or manufactured in Hong Kong, except goods in transit, in the course of transhipment and solely for export or re-export purpose. Other requirements are elaborated in the ensuing paragraphs.

VOC Content Limits

8. We propose to adopt 80 g/l and 500 g/l as the VOC content limits for fountain solutions and printing machine cleansing agents respectively. The former has been selected with reference to the limit of the South Coast Air Quality Management District (SCAQMD), California, the United States of America, which is one of the most stringent in use and has confirmed to be feasible by the study conducted in collaboration with the trade. Regarding printing machine cleansing agents, the study has found that cleansing agents meeting the SCAQMD standard of 100 g/l cannot remove the stains satisfactorily. A reasonable balance between the time required and ease of cleansing could be reached by using a solution with VOC content below 500 g/l. The proposed cap is hence set with reference to the operational needs of the printing industry in Hong Kong.

Determination of VOC Content

9. Similar to the current statutory arrangement, the Authority (i.e. the Director of Environmental Protection) will determine the VOC contents of fountain solution and printing machine cleansing agent as set out in ***Annex 2*** for checking the compliance of the statutory VOC limits. The proposed testing methods: the USEPA Method 24 '*Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings*'[4] to determine the VOC content of fountain solutions and printing machine cleansing agents, and the SCAQMD Method 303 '*Determination of Exempt of Compounds*'[5] to determine the content of exempt compounds shall be the version most recently approved by the relevant authorities.

Display of Product Information

10. To facilitate consumers to compare and choose the appropriate products, and the Authority to enforce the VOC Regulation, the proposal will require product information of fountain solutions and printing machine cleansing agents to be displayed in the product's Material Safety Data Sheet, catalogue, packaging or container. The product information should include product application, date of manufacture, manufacturer's recommendations regarding thinning, reducing, or mixing of product, the recommended mixing ratios, if applicable and the maximum VOC content in a ready to use condition.

Exemption

11. The VOC Regulation now provides that the Authority may in response to an application in writing grant exemption if –

(a) the product is irreplaceable in serving a vital public health or security function;
(b) the exemption would be in the public interest; or
(c) the product is manufactured or imported as a trade sample and is not intended for sale in Hong Kong.

We propose that the above exemption mechanism would also be applicable to the proposed control of fountain solutions and printing machine cleansing agents.

Annual Reporting and Record Keeping

12. To review the effectiveness of the proposed control, it is necessary to maintain accurate emission inventories before and after its implementation. We thus propose

[4] http://www.epa.gov/ttn/emc/promgate/m-24.pdf

[5] http://www.aqmd.gov/docs/default-source/laboratory-procedures/methods-procedures/303-91.pdf?sfvrsn=2

to extend the current reporting and record keeping system to importers and local manufacturers of fountain solutions and printing machine cleansing agents. They are required to report to the Authority on a confidential basis their sales information of such products including name of importer/manufacturer, the type, brand and full name of the product imported/manufactured, the weight or volume of the product sold and the VOC content in a ready to use condition annually. They are also required to keep the reported information for at least three years and produce for inspection if requested by the Authority.

Offences and Penalties

13. We also propose to apply the existing offences and penalties in the VOC Regulation for the proposed control for VOC contents of fountain solutions and printing machine cleansing agents. In summary, it would be an offence for any person who:

(i) imports into or manufactures in Hong Kong any fountain solution or printing machine cleansing agent exceeding the relevant limit of VOC content stated in paragraph 8;

(ii) fails to display the product information stated in paragraph 10;

(iii) fails to report annual sales amount, VOC content and other requested information;

(iv) fails to keep the reported records for at least three years or produce them upon request for inspection by the Authority; or

(v) knowingly or recklessly displays, gives, reports or records any information that is misleading, false or incomplete.

Details of the proposed penalties are at ***Annex 3***.

Effective Date

14. We propose the control measures stated in paragraphs 7 to 13 above, except paragraph 12, to be effective on **1 January 2018**.

15. For the reporting requirement in paragraph 12, it will be effective on **1 January 2019**. The first annual report covering the preceding year (i.e. 2018) has to be submitted by 31 March 2019. This arrangement is the same as that for VOC containing products now under control of the VOC Regulation.

VOC REDUCTION

16. In 2013, 1,800 tonnes of VOC were emitted from fountain solutions and printing machine cleansing agents used for printing. The implementation of the new control proposal would reduce 420 tonnes of VOC annually.

CONSULTATION PLAN

17. We plan to consult the stakeholders between February and April 2016. We will arrange two briefing sessions for the interested parties to explain our proposal and to hear their feedback as follows:

Date	**Time**	**Venue**
15 March 2016	10:30 a.m.	Auditorium, the Boys' & Girls' Clubs Association of Hong Kong Headquarters Building
14 April 2016	3:00 p.m.	Auditorium, the Hong Kong Federation of Youth Groups Building

18. We will finalize the proposal in the second quarter of 2016. We will then consult the Advisory Council on the Environment and the Panel on Environmental Affairs of the Legislative Council.

VIEWS SOUGHT

19. We invite your views on the proposed regulatory control scheme for fountain solutions and printing machine cleansing agents. Please send them to us on or before **30 April 2016** by mail/electronic mail/facsimile to the following:

Environmental Protection Department
33/F, Revenue Tower
5 Gloucester Road
Wanchai, Hong Kong
(Attn.: VOC Consultation)

E-mail address: VOCConsult@epd.gov.hk

Facsimile: 2838 2155

20. Please note that the Government would wish, either in discussion with others or in any subsequent report, whether privately or publicly, to be able to refer to and attribute views submitted in response to this consultation document. Any request to treat all

or part of a response in confidence will be respected, but if no such request is made, it will be assumed that the response is not intended to be confidential.

Environmental Protection Department
January 2016

Annex 1

Feasibility Study on Measures to Reduce VOC Emissions from printing

The Environmental Protection Department (EPD) commissioned Hong Kong Productivity Council (HKPC) in 2012 to identify feasible VOC reduction measures for the printing industry in collaboration with the printing trade. A Working Group on Reducing VOC - Printing Industry (Working Group) comprising representatives of the Hong Kong Printers Association and the Graphic Arts Association of Hong Kong and EPD was formed to oversee the feasibility study.

2. With the endorsement of the Working Group, HKPC conducted demonstration tests for the following five VOC reduction options in local printing factories, which are mostly small scale with limited space:

(a) low VOC fountain solutions;
(b) low VOC printing machine cleansing agents;
(c) water based varnishing;
(d) solvent recovery system; and
(e) cleansing agent filtration system.

3. The tests were conducted between September 2012 and February 2013 and the findings are as follows:

3.1 <u>Low VOC fountain solutions</u>

3.1.1 Three tests were conducted in three different local factories to test the performance of low VOC fountain solutions. In the first test, a 20 years old printing machine was used to print four batches of 5,000 standard printing plates (28 inch x 40 inch). Three of them were printed using three different brands of low VOC fountain solutions meeting the South Coast Air Quality Management District (SCAQMD) limit of 80 g/l. A conventional fountain solution with VOC content exceeding 80 g/l was used to print the remaining batch. Technical performance parameters including drying speed, printing density, dot gain value, trapping, etc. were evaluated. It was found that all the technical performance parameters of the three low VOC fountain solutions were comparable to those of the conventional fountain solution, affirming the satisfactory performance of low VOC fountain solutions.

3.1.2 The above test was repeated using a six years old printing machine in another

printing factory. As the first test, the second test reconfirmed the satisfactory performance of low VOC fountain solutions.

3.1.3 A third test was conducted in another printing factory to test the performance of low VOC fountain solution with different types of paper commonly used for printing in Hong Kong. One of the three brands of low VOC fountain solution used in the previous tests was used for performance comparison with a conventional fountain solution. Batches of 5,000 poster size gloss art papers, matt coated papers and woodfree papers were used for testing. It was found that all the technical performance parameters of the low VOC fountain solution were comparable to those of the conventional fountain solution in all the three types of paper.

3.1.4 The three tests confirmed the feasibility and satisfactory performance of using low VOC fountain solutions in local factories. The cost of low VOC fountain solution is slightly higher than that of the conventional fountain solution. The average increase in cost was HK$3 per 5,000 sheets.

3.2 Low VOC printing machine cleansing agents

3.2.1 Three different brands of low VOC printing machine cleansing agents meeting the SCAQMD limit of 100 g/l and a conventional printing machine cleansing agent which contains 100% VOC were used for testing. The test was done in conjunction with the first low VOC fountain solution test as described in paragraph 3.1.1 above. The printing machine cleansing agents were used to clean the machine after each batch of printing was completed. Technical parameters of the low VOC printing machine cleansing agents such as cleansing power, drying speed, odour and flammability were evaluated against those of the conventional printing machine cleansing agents. The cleansing power of all the three low VOC printing machine cleansing agents was considered **unacceptable** because stains could not be removed even after 10 wipes.

3.2.2 The above test was repeated by using printing machine cleansing agents with VOC contents between 300 g/l and 500 g/l as part of the second low VOC fountain solution test as described in paragraph 3.1.2 above. The stains were removed after 3-4 wipes by using the low VOC printing machine cleansing agents whereas only 1-2 wipes were needed if conventional printing machine cleansing agent was used. The cleansing power of the low VOC printing machine cleansing agents was considered acceptable but they took 1-2 more minutes to dry. The low VOC printing machine cleansing agents were less odorous and less flammable than the conventional printing

machine cleansing agent. Their cleansing performance was considered satisfactory. Its use by the local factories is considered feasible because a reasonable balance of the time required and ease of cleansing could be reached.

3.2.3 The cost of low VOC printing machine cleansing agents is slightly higher than that of the conventional printing machine cleansing agents. The average increase in cost was $16 per 5,000 sheets.

3.3 Water based varnishing

3.3.1 Three different brands of water based varnishes and a solvent based varnish were used to apply coating to batches of 5,000 sheets. The technical performance such as gloss points and colour changes of the water based varnishes was compared with those of the solvent based varnish. The performance of the water based varnishes was found to be better.

3.3.2 The cost of water based varnishes is higher than that of solvent based varnishes. The average increase in material cost of using water based varnishes for coating 5,000 sheets was $164. Water based varnishing requires the use of a 5-colour printer equipped with a special component (a chamberdoctor blade system). In Hong Kong, 5-colour printers are not commonly used and the addition of a special component means higher capital investment. Furthermore, some factories may not have space to add the special component. All these factors make water based varnishing difficult to be adopted in the small factories in Hong Kong.

3.4 Solvent recovery system

3.4.1 A solvent recovery system was used to regenerate solvent from waste solvent produced from printing process by distillation. The test was done in a factory in the Mainland because the supplier of the solvent recovery system was not willing to ship the machine to Hong Kong. The recovery rate was found to be 82%.

3.4.2 The cost of the solvent recovery system was about $46,500. Its size (66 cm x 51 cm x 105 cm) is relatively small. Solvent recovery system is attractive for factories with a high solvent consumption. For the small scale factories in Hong Kong, their solvent consumption rate may be too low to make the solvent recovery system a cost effective option.

3.5 Cleansing agent filtration system

3.5.1 The test was done in a factory equipped with a cleansing agent filtration system in the Mainland. A printing machine fitted with an automatic spraying system was used to apply filtered cleansing agent to clean the machine. Two other printing machines were cleaned manually by conventional and low VOC printing machine cleansing agents. Their technical parameters such as cleansing power, drying speed, odour and flammability were recorded for comparison. It was found that the performance of filtered cleansing agent compared favorably with that of the conventional cleansing agent.

3.5.2 The cost of a filtration system was about $400,000. It could save 68% of the cleansing agent consumption. While its performance was found to be satisfactory, filtration system is more suitable for large factories with high solvent consumption. As this technology requires high investment cost and high solvent consumption rate, it is considered not suitable for the small factories in Hong Kong.

Annex 2

Determination of VOC Content

(1) "VOC content" means the content of VOC in a ready to use condition calculated by the following formula –

$$\frac{Wa - Wb - Wc}{Vd}$$

where –

Wa represents the weight of volatile matters in grams as determined by Method 24;

Wb represents the weight of water in grams as determined by Method 24;

Wc represents the weight of exempt compounds in grams as determined by Method 303;

Vd represents the volume of material in litres as determined by Method 24.

(2) "Ready to use condition" means if dilution with solvent or thinner or mixing of components is recommended by the manufacturer on a product, the condition of the product with the maximum VOC content after dilution or mixing according to the dilution or mixing ratio recommended on the product. Otherwise, it refers to the condition of a product in which it is supplied in the packaging or container.

(3) "Exempt compound" means any of the following compounds –

(a) acetone;

(b) 1-chloro-1,1-difluoroethane (HCFC-142b);

(c) chlorodifluoromethane (HCFC-22);

(d) 1-chloro-1-fluoroethane (HCFC-151a);

(e) chlorofluoromethane (HCFC-31);

(f) chloropentafluoroethane (CFC-115);

(g) 2-chloro-1,1,1,2-tetrafluoroethane (HCFC-124);

(h) cyclic, branched, or linear, completely fluorinated alkanes;

(i) cyclic, branched, or linear, completely fluorinated ethers with no unsaturations;

(j) cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations;

(k) cyclic, branched, or linear, completely methylated siloxanes (VMS);

(l) 1,1,1,2,3,4,4,5,5,5-decafluoropentane (HFC-43-10mee);

(m) dichlorodifluoromethane (CFC-12);

(n) 1,1-dichloro-1-fluoroethane (HCFC-141b);

(o) 3,3-dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca);
(p) 1,3-dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb);
(q) 1,2-dichloro-1,1,2,2-tetrafluoroethane (CFC-114);
(r) 2,2-dichloro-1,1,1-trifluoroethane (HCFC-123);
(s) 1,2-dichloro-1,1,2-trifluoroethane (HCFC-123a);
(t) 1,1-difluoroethane (HFC-152a);
(u) difluoromethane (HFC-32);
(v) 2-(difluoromethoxymethyl)-1,1,1,2,3,3,3-heptafluoropropane ($(CF_3)_2CFCF_2OCH_3$);
(w) ethane;
(x) 2-(ethoxydifluoromethyl)-1,1,1,2,3,3,3-heptafluoropropane ($(CF_3)_2CFCF_2OC_2H_5$);
(y) 1-ethoxy-1,1,2,2,3,3,4,4,4-nonafluorobutane ($C_4F_9OC_2H_5$);
(z) ethylfluoride (HFC-161);
(za) 1,1,1,2,3,3-hexafluoropropane (HFC-236ea);
(zb) 1,1,1,3,3,3-hexafluoropropane (HFC-236fa);
(zc) methyl acetate;
(zd) methylene chloride (dichloromethane);
(ze) 1,1,1,2,2,3,3,4,4-nonafluoro-4-methoxy-butane ($C_4F_9OCH_3$);
(zf) parachlorobenzotrifluoride (PCBTF);
(zg) 1,1,1,3,3-pentafluorobutane (HFC-365mfc);
(zh) pentafluoroethane (HFC-125);
(zi) 1,1,2,2,3-pentafluoropropane (HFC-245ca);
(zj) 1,1,2,3,3-pentafluoropropane (HFC-245ea);
(zk) 1,1,1,2,3-pentafluoropropane (HFC-245eb);
(zl) 1,1,1,3,3-pentafluoropropane (HFC-245fa);
(zm) perchloroethylene (tetrachloroethylene);
(zn) sulphur-containing perfluorocarbons with no unsaturations and with sulphur bonds only to carbon and fluorine;
(zo) 1,1,2,2-tetrafluoroethane (HFC-134);
(zp) 1,1,1,2-tetrafluoroethane (HFC-134a);
(zq) 1,1,1-trichloroethane (methyl chloroform);
(zr) trichlorofluoromethane (CFC-11);
(zs) 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113);
(zt) 1,1,1-trifluoroethane (HFC-143a);
(zu) trifluoromethane (HFC-23);
(zv) methyl formate;
(zw) propylene carbonate;
(zx) 1,1,1,2,3,3,3-heptafluoropropane (HFC-227ea);

(zy) trans-1,3,3,3-tetrafluoropropene (HFO-1234ze);
(zz) trans-1-chloro-3,3,3-trifluoropropene (HFO-1233zd).

Annex 3

Maximum Penalties for Various Offences

Offence	Maximum Penalty
Importing into or manufacturing in Hong Kong any fountain solution or printing machine cleansing agent exceeding the relevant limit of VOC content	$200,000 and 6 months' imprisonment
Failing to display product information	$50,000 and 3 months' imprisonment
Failing to report annual sales amount, VOC content and other requested information requested by the Authority	
Failing to keep the reported records for at least three years or produce them upon request for inspection by the Authority	
Knowingly or recklessly displaying, giving, reporting or recording any information that is misleading, false or incomplete	