For discussion on
28 November 2016

LEGISLATIVE COUNCIL
PANEL ON ENVIRONMENTAL AFFAIRS

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

PURPOSE

This paper briefs Members on our 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.

BACKGROUND

2. VOC are organic chemicals that evaporate at room temperature. Some of them are toxic while most could contribute to the formation of photochemical smog, which is a key regional air pollution problem in the Pearl River Delta (PRD). The combat against VOC problems requires both local efforts and regional cooperation.

3. In Hong Kong, non-combustion sources (mainly VOC containing products such as paints, consumer products, printing inks, adhesives and sealants) are the major contributor to man-made VOC emissions. We started regulating the VOC contents of products of non-combustion sources in 2007 via the Air Pollution Control (Volatile Organic Compounds) Regulation (CAP. 311w) (VOC Regulation). These efforts have paid dividend with VOC emissions from non-combustion sources dropping from 28,210 tonnes (accounting for 68% of the total VOC emissions) in 2007 to 15,600 tonnes (accounting for 58% of the total VOC emissions) in 2014.

4. The VOC Regulation bans the import and local manufacture[1] of specified products if their VOC contents exceed the relevant prescribed limits. To facilitate consumers' comparison and choice of products, the VOC Regulation requires display

[1] The VOC Regulation does not apply to goods in transit, in the course of transshipment or that are solely for export or re-export.

of relevant product information (including 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) in the product's Material Safety Data Sheet, catalogue, packaging or container, as appropriate. To maintain effective monitoring, the VOC Regulation also prescribes a reporting and record keeping system under which importers and local manufacturers are required to report to the Authority (i.e. the Director of Environmental Protection) 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 regarding importing and manufacturing attract a fine of $200,000 and 6 months' imprisonment. Offences on product information display, report and record keeping attract a fine of $50,000 and 3 months' imprisonment. At present, 170 types of products are under the control of the VOC Regulation.

THE STUDY ON FOUNTAIN SOLUTIONS AND PRINTING MACHINE CLEANSING AGENTS

5. To further reduce VOC emissions for better air quality, we have been exploring additional measures to control VOC from non-combustion sources.

6. Fountain solution is the solution used in lithographic printing. It 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.

7. The average VOC content (i.e. the VOC content in a ready to use condition)[2] of conventional fountain solutions and printing machine cleansing agents are 92 grams per litre (g/l) and 780 g/l respectively. 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

[2] Usually, a fountain solution will have to be mixed with water and isopropyl alcohol as recommended by its manufacturer to make it ready to use. Similar mixing might also be required for a printing machine cleansing agent though this is uncommon.

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] (the Working Group) was formed to oversee the feasibility study. The study trialed fountain solutions and printing machine cleansing agents with a lower VOC content in local printing factories, including many small scale ones, from September 2012 to February 2013. The trials confirmed that fountain solutions and printing machine cleansing agents with VOC content not exceeding 80 g/l and 500 g/l respectively can perform well just like their conventional counterparts in printing applications. The additional cost incurred is less than 0.4 cent per sheet for printing 5,000 standard printing plates (paper size in 71cm x 102 cm). 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 solutions and printing machine cleansing agents only accounts for a very small portion of the total production cost. We 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

8. 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 not exceeding 80 g/l and printing machine cleansing agents of VOC content not exceeding 500 g/l to the local market. A survey has also been done to check the availability of these products on 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 required to use them.

THE PROPOSAL

Control Framework

9. We propose to apply the VOC Regulation to fountain solutions and printing machine cleansing agents. In gist, fountain solutions and printing machine cleansing

[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.

agents with VOC content exceeding prescribed limits cannot be imported to or manufactured in Hong Kong. Other requirements, including product information display, report and record keeping etc., also apply. No changes are proposed to the offences and penalties provisions.

Proposed prescribed VOC Content Limits

10. In line with the findings of the feasibility study conducted in collaboration with the trade as mentioned in paragraph 7 above, and with reference to the limits[4] of the South Coast Air Quality Management District (SCAQMD)[5], California, the USA, 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.

Determination of VOC Content

11. As with the current statutory arrangement, the VOC Regulation will prescribe the method of calculating and determining the VOC contents of fountain solutions and printing machine cleansing agents, for ascertaining whether the prescribed VOC limits are complied. The prescribed method is set out in **Annex 2**.

VOC REDUCTION

12. In 2014, 1,500 tonnes of VOC were emitted from fountain solutions and printing machine cleansing agents used for printing in Hong Kong. The implementation of the new control proposal is expected to reduce 370 tonnes of VOC annually.

PUBLIC CONSULTATION

13. In addition to our continued dialogue with the trade as early as the

[4] SCAQMD's VOC content limits for fountain solutions and printing machine cleansing agents are one of the most stringent in use. The current limits are 50g/l and 100 g/l respectively.

[5] While SCAQMD has tightened its VOC limit for fountain solutions to 50 g/l after the completion of our feasibility study, we do not consider it appropriate to adopt it because the study has found that old printing machines using fountain solutions of such a low VOC level could have unsatisfactory printing performance. 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. The proposed caps are hence set with reference to the operational needs of the printing industry in Hong Kong.

undertaking of the feasibility study in 2012, we issued a consultation paper on 27 January 2016, inviting comments from over 4,000 relevant stakeholders including manufacturers, suppliers, trade associations, printing companies, green groups, Government departments, professional and academic institutions on the proposal. We also held two briefing sessions in March and April 2016 to explain the details to the trade and stakeholders.

14. The proposals in paragraphs 9 to 11 are generally supported by the stakeholders and no adverse feedback was received during the 3-month consultation.

LEGISLATIVE TIMETABLE

15. We aim at introducing the amendment of the VOC regulation to the Legislative Council in the fourth quarter of 2017, for implementation with effect from **1 January 2018**.

ADVICE SOUGHT

16. Members are invited to comment on the proposal set out in paragraphs 9 to 11 of this paper.

Environmental Protection Department
November 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. The study concluded that the use of fountain solutions and printing machine cleansing agents with low VOC content (i.e. not exceeding 80 g/l and 500 g/l respectively in a ready to use condition) are feasible with insignificant cost implication. Key findings of the trial use of low VOC fountain solutions and printing machine cleansing agents at local printing factories are elaborated in ensuing paragraphs.

2 Low VOC fountain solutions

2.1 Three trials were conducted in three different local factories on the use of low VOC fountain solutions. In the first test, a 20-year-old printing machine was used to print four batches of 5,000 standard printing plates (71cm x 102 cm). Three of them were printed with three different brands of fountain solutions with a VOC content meeting the prevailing South Coast Air Quality Management District (SCAQMD) limit of 80 g/l at the time of testing. The remaining batch of printing plates was printed with conventional fountain solution with a VOC content exceeding 80 g/l. The three different brands of low VOC fountain solutions were supposed to work with a VOC content below 50 g/l. However, two of them could only achieve satisfactory printing performance with VOC contents at 54 g/l and 68 g/l respectively. One brand could achieve satisfactory printing performance at a VOC content below 50 g/l.

2.2 The above test was repeated on a six-year-old printing machine in another printing factory. The test confirmed the satisfactory use of the low VOC fountain solutions with a VOC content below 50 g/l.

2.3 A third test was conducted in another new printing machine using different types of paper commonly used for printing in Hong Kong. A fountain solution with a VOC content below 50 g/l 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 in using the low VOC fountain solution were comparable to those with conventional fountain solution in all the three types of paper.

2.4 The three tests confirmed the feasibility and satisfactory performance of using low VOC fountain solutions with the VOC content capped at 80 g/l in local printing factories. The results did not support aligning the VOC content limit with the latest standard of SCAQMD (i.e. 50 g/l) because of the adverse implications for the printing performance of old printing machines. The cost of low VOC fountain solution is slightly higher than that of the conventional fountain solution. The average increase in cost was $3 per 5,000 sheets.

3. Low VOC printing machine cleansing agents

3.1 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 trial. The test was done in conjunction with the first low VOC fountain solution test as described in paragraph 2.1 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 with conventional printing machine cleansing agents. The cleansing power of all the three low VOC printing machine cleansing agents was considered **not acceptable** because stains could not be removed even after 10 wipes.

3.2 The above test was repeated by using another three printing machine cleansing agents with VOC contents between 300 g/l and 500 g/l with the second low VOC fountain solution test as described in paragraph 2.2 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 though 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.

3.3 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.

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[6] –

(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;

[6] Reference has been made to SCAQMD's list of exempt compounds for fountain solutions and printing machine cleansing agents.

(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).

Note: The proposed testing methods, the USEPA Method 24 '*Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings*'[7] to determine the VOC content of fountain solutions and printing machine cleansing agents, and the SCAQMD Method 303 '*Determination of Exempt of Compounds*'[8] to determine the content of exempt compounds, shall be the version most recently approved by the relevant authorities.

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

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