**SUPPLEMENTARY INFORMATION**

Manuscript title: Volatile organic compounds (VOCs) in surface coating materials: their compositions and potential as an alternative fuel

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Figure S1. A schematic of sampling system for VOCs emission.

Figure S2. Small scale incinerator for used activated carbon.

**Table S1**. List of ozone precursor (PAMS mix)

| **No.** | **Compounds** | **CAS number** | **Formular** | **Molar mass  (g/mol)** | **Density (g/L)** | **Concentration (ppb)** |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Acetylene | 74-86-2 | C2H2 | 26.04 | 1.097 | 100 |
| 2 | Benzene | 71-43-2 | C6H6 | 78.11 | 876.5 | 100 |
| 3 | Butane | 106-97-8 | C4H10 | 58.12 | 2.48 | 100 |
| 4 | 1-Butene | 106-98-9 | C4H8 | 56.11 | 620 | 100 |
| 5 | cis-2-Butene | 590-18-1 | C4H8 | 56.1 | 641 | 100 |
| 6 | trans-2-Butene | 624-64-6 | C4H8 | 56.1 | 626 | 100 |
| 7 | Cumene | 98-82-8 | C9H12 | 120.19 | 862 | 100 |
| 8 | Cyclohexane | 110-82-7 | C6H12 | 84.16 | 778.1 | 100 |
| 9 | Cyclopentane | 287-92-3 | C5H10 | 70.1 | 751 | 100 |
| 10 | Decane | 124-18-5 | C10H22 | 142.28 | 730 | 100 |
| 11 | 1,3-Diethylbenzene | 141-93-5 | C10H14 | 134.22 | 864 | 100 |
| 12 | 1,4-Diethylbenzene | 105-05-5 | C10H14 | 134.22 | 862 | 100 |
| 13 | 2,2-Dimethylbutane | 75-83-2 | C6H14 | 86.18 | 649 | 100 |
| 14 | 2,3-Dimethylbutane | 79-29-8 | C6H14 | 86.18 | 662 | 100 |
| 15 | 2,3-Dimethylpentane | 565-59-3 | C7H16 | 100.2 | 695 | 100 |
| 16 | 2,4-Dimethylpentane | 108-08-7 | C7H16 | 100.2 | 673 | 100 |
| 17 | Dodecane | 112-40-3 | C12H26 | 170.33 | 780.8 | 100 |
| 18 | Ethane | 74-84-0 | C2H6 | 30.07 | 1.356 | 100 |
| 19 | Ethyl benzene | 100-41-4 | C8H10 | 106.17 | 866.5 | 100 |
| 20 | Ethylene | 74-85-1 | C2H4 | 28.05 | 1.178 | 100 |
| 21 | 3-Ethyl toluene | 620-14-4 | C9H12 | 120.19 | 865 | 100 |
| 22 | 2-Ethyl toluene | 611-14-3 | C9H12 | 120.19 | 887 | 100 |
| 23 | 4-Ethyl toluene | 622-96-8 | C9H12 | 120.19 | 861 | 100 |
| 24 | Heptane | 142-82-5 | C7H16 | 100.2 | 679.5 | 100 |
| 25 | Hexane | 110-54-3 | C6H14 | 86.18 | 654.8 | 100 |
| 26 | 1-Hexene | 592-41-6 | C6H12 | 84.16 | 673 | 100 |
| 27 | Isoprene | 78-79-5 | C5H8 | 68.12 | 681 | 100 |
| 28 | 1,3,5-trimethyl benzene | 108-67-8 | C9H12 | 120.19 | 863.7 | 100 |
| 29 | 2-Methyl propane | 75-28-5 | C4H10 | 58.12 | 2.51 | 100 |
| 30 | 2-Methyl butane | 78-78-4 | C5H12 | 75.15 | 616 | 100 |
| 31 | Methyl cyclohexane | 108-87-2 | C7H14 | 98.19 | 770 | 100 |
| 32 | Methyl cyclopentane | 96-37-7 | C6H12 | 84.16 | 749 | 100 |
| 33 | 2-Methyl heptane | 592-27-8 | C8H18 | 114.23 | 698 | 100 |
| 34 | 3-Methyl heptane | 589-81-1 | C8H18 | 114.23 | 705 | 100 |
| 35 | 2-Methyl hexane | 591-76-4 | C7H16 | 100.2 | 679 | 100 |
| 36 | 3-Methyl hexane | 589-34-4 | C7H16 | 100.2 | 686 | 100 |
| 37 | 2-Methyl pentane | 107-83-5 | C6H14 | 86.18 | 653 | 100 |
| 38 | 3-Methyl pentane | 96-14-0 | C6H14 | 86.18 | 664 | 100 |
| 39 | Nonane | 111-84-2 | C9H20 | 128.26 | 718 | 100 |
| 40 | Octane | 111-65-9 | C8H18 | 114.23 | 703 | 100 |
| 41 | Pentane | 109-66-0 | C5H12 | 72.15 | 626 | 100 |
| 42 | 1-Pentene | 109-67-1 | C5H10 | 70.13 | 640 | 100 |
| 43 | cis-2-Pentene | 627-20-3 | C5H10 | 70.13 | 657 | 100 |
| 44 | trans-2-Pentene | 640-04-8 | C5H10 | 70.13 | 651 | 100 |
| 45 | Propane | 74-98-6 | C3H8 | 44.1 | 2.009 | 100 |
| 46 | Propyl benzene | 103-65-1 | C9H12 | 120.19 | 862 | 100 |
| 47 | Propylene | 115-07-1 | C3H6 | 42.08 | 1.81 | 100 |
| 48 | Styrene | 100-42-5 | C8H8 | 104.15 | 909 | 100 |
| 49 | Toluene | 108-88-3 | C7H8 | 92.14 | 870 | 100 |
| 50 | 1,2,3-Trimethyl benzene | 526-73-8 | C9H12 | 120.19 | 890 | 100 |
| 51 | 1,2,4-Trimethyl benzene | 95-63-6 | C9H12 | 120.19 | 876.1 | 100 |
| 52 | 2,2,4-Trimethyl pentane | 540-84-1 | C8H18 | 114.23 | 692 | 100 |
| 53 | 2,3,4-Trimethyl pentane | 565-75-3 | C8H18 | 114.23 | 719 | 100 |
| 54 | Undecane | 1120-21-4 | C11H24 | 156.3 | 740 | 100 |
| 55 | o-Xylene | 95-47-6 | C8H10 | 106.17 | 880 | 100 |
| 56 | m/p-Xylene | 179601-23-1 | C8H10 | 106.17 | 860 | 100 |
| 57 | Nitrogen | 9017-40-7 | N2 |  |  |  |

**Table S2**. Composition ratios of the target VOCs from marine ship surface coatings

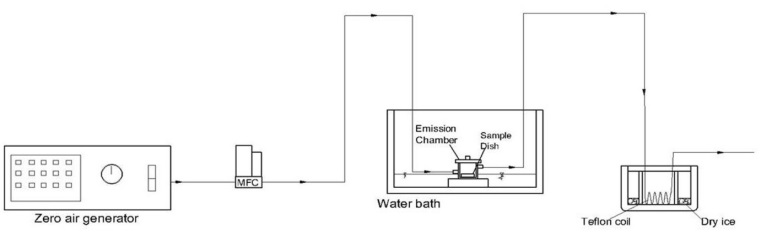
|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Compounds** | **Composition ratios (Wt%)** | | | | | | | | | |
| **S1** | **S2** | **S3** | **S4** | **S5** | **S6** | **S7** | **S8** | **S9** | **S10** |
| Octane | - | - | - | 0.22 | - | - | 0.16 | - | - | - |
| Benzene | 0.29 | 0.14 | - | - | - | - | - | - | - | - |
| Toluene | 0.23 | 1.42 | 0.24 | 0.20 | 0.37 | 0.04 | 0.67 | 3.25 | - | 0.04 |
| Ethyl benzene | 2.0 | 3.5 | 3.8 | 2.67 | 2.9 | 1.2 | 3.1 | 8.1 | 0.50 | 2.24 |
| *m/p*-xylene | 5.8 | 7.8 | 9.9 | 10.7 | 10.0 | 2.5 | 11.2 | 11.9 | 10.09 | 9.12 |
| *n*-nonane | - | - | - | 2.47 | - | 1.2 | 2.32 | 0.23 | - | - |
| *o*-xylene | 2.4 | 3.5 | 4.3 | 3.7 | 4.0 | - | 3.5 | 2.80 | 4.84 | 5.05 |
| Cumene | 0.07 | 0.07 | - | - | - | 0.002 | - | - | 0.07 | 0.05 |
| *n*-propyl benzene | 0.08 | 0.11 | - | - | - | 0.01 | - | - | 0.09 | 0.08 |
| 3-ethyl toluene | 0.63 | 0.81 | 0.05 | - | 0.35 | 0.11 | - | 0.29 | 0.49 | 0.44 |
| 4-ethyl toluene | 0.48 | 0.64 | 0.03 | - | 0.23 | 0.07 | - | 0.18 | 0.39 | 0.34 |
| 1,2,4-trimethyl benzene | 0.33 | 0.42 | 0.01 | - | 0.16 | 0.06 | - | 0.16 | 0.20 | 0.19 |
| *n*-decane | - | - | - | 1.70 | - | - | 1.04 | - | - | - |
| 1,2,3-trimethyl benzene | 1.32 | 1.44 | 0.15 | - | 0.75 | 0.23 | - | 0.66 | 0.80 | 0.70 |
| 1,3,5-trimethyl benzene | 0.13 | 0.15 | - | 1.31 | - | 0.01 | 0.79 | - | 0.07 | 0.06 |
| *n*-undecane | - | - |  | 0.85 | - | - | 0.24 | - | - | - |

**Table S3**. Composition ratios of the target VOCs from architectural surface coatings

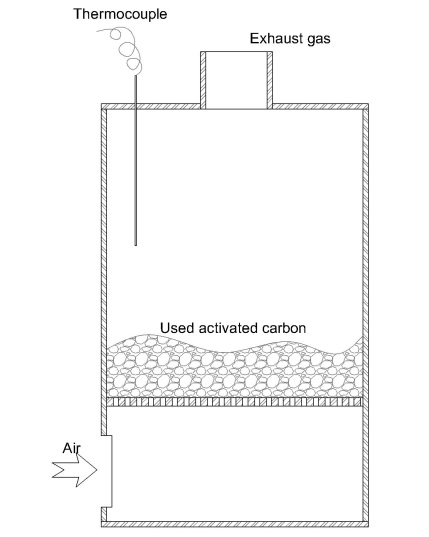
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Compounds** | **Composition ratios (Wt%)** | | | | | | | | | | | | | | | |
| **A1** | **A2** | **A3** | **A4** | **A5** | **A6** | **A7** | **A8** | **A9** | **A10** | **A11** | **A12** | **A13** | **A14** | **A15** | **A16** |
| 2-methyl butane | - | - | - | - | 1.70 | 3.87 | - | - | - | - | - | - | - | - | - | - |
| 1-pentene | - | - | - | - | 6.06 | 4.18 | - | - | - | - | - | - | - | - | - | - |
| Octane | - | - | - | - | 0.11 | 0.15 | - | - | - | - | - | - | - | - | - | - |
| 2,2-dimethyl butane | - | - | - | - | 0.04 | 0.22 | - | - | - | - | - | - | - | - | - | - |
| 2,3-dimethyl butane | - | - | - | - | 1.21 | 2.25 | - | - | - | - | - | - | - | - | - | - |
| *n*-pentane | - | - | - | - | 4.25 | 4.47 | - | - | - | - | - | - | - | - | - | - |
| 2-methyl pentane | - | - | - | - | 9.05 | 6.14 | - | - | - | - | - | - | - | - | - | - |
| 3-methyl pentane | - | - | - | - | 3.06 | 3.04 | - | - | - | - | - | - | - | - | - | - |
| *n*-hexane | - | - | - | - | 3.03 | 2.78 | - | - | - | - | - | - | - | - | - | - |
| Methyl cyclopentane | - | - | - | - | 2.39 | 2.06 | - | - | - | - | - | - | - | - | - | - |
| Cyclohexane | - | - | - | - | 3.08 | 3.24 | - | - | - | - | - | - | - | - | - | - |
| 2,3-dimethyl pentane | 0.002 | - | - | - | 0.08 | 0.34 | - | - | - | - | - | - | - | - | - | - |
| 2-methyl hexane | - | - | - | - | 1.01 | 1.22 | - | - | - | - | - | - | - | - | - | - |
| 3-methyl hexane | - | - | - | - | 1.00 | 1.53 | - | - | - | - | - | - | - | - | - | - |
| *n*-heptane | - | - | - | - | 0.08 | 2.17 | - | - | - | - | - | - | - | - | - | - |
| Benzene | 0.009 | - | - | - | 0.18 | 0.40 | - | - | 0.59 | - | - | 0.38 | - | - | 0.04 | - |
| 2,2,4-trimethyl pentane | 0.198 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Methyl cyclohexane | - | - | - | - | 2.26 | 1.29 | - | - | - | - | - | - | - | - | - | - |
| 2,3,4-trimethyl pentane | 0.004 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2-methyl heptane | - | - | - | - | 0.06 | 0.05 | - | - | - | - | - | - | - | - | - | - |
| 3-methylheptane | - | - | - | - | 0.03 | 0.12 | - | - | - | - | - | - | - | - | - | - |
| Toluene | - | 0.22 | 21.3 | 0.11 | 0.10 | 0.09 | 1.37 | 12.2 | 17.62 | - | 5.71 | 0.19 | 2.74 | 4.77 | 15.61 | 1.08 |
| Ethyl benzene | 0.034 | 0.19 | 1.8 | 0.66 | 0.11 | 0.78 | 0.95 | 3.2 | 5.98 | 7.40 | 9.24 | 3.64 | 1.49 | 0.69 | 0.66 | 0.22 |
| *m/p*-xylene | - | 1.31 | 9.4 | 5.26 | 0.03 | 0.60 | 0.83 | 1.8 | 2.33 | 3.97 | 7.35 | 9.31 | 0.71 | 0.40 | 3.48 | 0.90 |
| *n*-nonane | - | - | - | 6.06 | 0.02 | 0.10 | 2.50 | - | - | 0.00 | 0.02 | - | - | - | - | - |
| *o*-xylene | - | - | 2.2 | 2.32 | 0.09 | 0.14 | - | 0.3 | 0.48 | 0.82 | 1.39 | 3.95 | 0.09 | 0.06 | 0.94 | 0.38 |
| Styrene | 0.043 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Cumene | - | - | - | - | - | - | - | - | - | - | 0.06 | - | - | - | - | - |
| *n*-propyl benzene | - | - | - | 0.13 | - | - | - | - | - | - | 0.03 | - | - | - | - | - |
| 3-ethyl toluene | - | - | - | 1.08 | - | - | - | - | - | - | 0.02 | - | - | - | - | - |
| 4-ethyl toluene | - | - | - | 0.46 | - | - | - | - | - | - | 0.04 | - | - | - | - | - |
| 1,2,4-trimethyl benzene | - | - | - | 1.60 | - | - | - | - | - | - | 0.01 | - | - | - | - | - |
| *n*-decane | - | - | - | 1.36 | - | 0.02 | 1.38 | - | - | 1.11 | - | - | - | - | - | - |
| 1,2,3-trimethyl benzene | - | - | - | 2.00 | - | 0.04 | - | - | - | - | - | - | - | - | - | - |
| 1,3,5-trimethyl benzene | - | - | - | 0.46 | - | - | - | - | - | - | 0.04 | - | - | - | - | - |
| *n*-undecane | - | - | - | 0.15 | - | - | - | - | - | - | - | - | - | - | - | - |

**Table S4**. Composition ratios of the target VOCs from automotive surface coatings

| **Compounds** | **Composition ratios (Wt%)** | | | | |
| --- | --- | --- | --- | --- | --- |
| **C1** | **C2** | **C3** | **C4** | **C5** |
| 2-methyl pentane | - | - | - | - | 2.56 |
| 3-methyl pentane | - | - | - | - | 2.31 |
| *n*-hexane | - | - | - | - | 0.01 |
| Methyl cyclopentane | - | - | - | - | 2.12 |
| Cyclohexane | - | - | - | - | 3.37 |
| 2,3-dimethyl pentane | - | - | - | - | 1.12 |
| 2-methyl hexane | - | - | - | - | 2.64 |
| 3-methyl hexane | - | - | - | - | 2.54 |
| *n*-heptane | - | - | - | - | 3.65 |
| Benzene | - | - | - | - | 2.14 |
| Methyl cyclohexane | - | - | - | - | 3.60 |
| Toluene | 10.7 | 33.7 | 33.1 | 32.5 | 3.87 |
| Ethyl benzene | 9.85 | 2.59 | 2.85 | 2.32 | 0.71 |
| *m/p*-xylene | 17.9 | 14.1 | 14.9 | 13.1 | 2.14 |
| *n*-nonane | - | - | - | - | 0.03 |
| *o*-xylene | 4.00 | 2.88 | 3.08 | 2.74 | 0.54 |
| 3-ethyl toluene | 0.73 | - | - | - | - |
| 4-ethyl toluene | 0.52 | - | - | - | - |
| 1,2,4-trimethyl benzene | 1.04 | 0.24 | - | - | - |
| 1,3,5-trimethyl benzene | 0.30 | 0.46 | 0.45 | 0.46 | - |



**Figure S1**. A schematic of sampling system for VOCs emission.



**Figure S2**. Small scale incinerator for used activated carbon.