Supplementary Material: Effect of 3D-Printed Thermoplastics Used in Sensor Housings on Common Atmospheric Trace Gasses

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Figure S.1

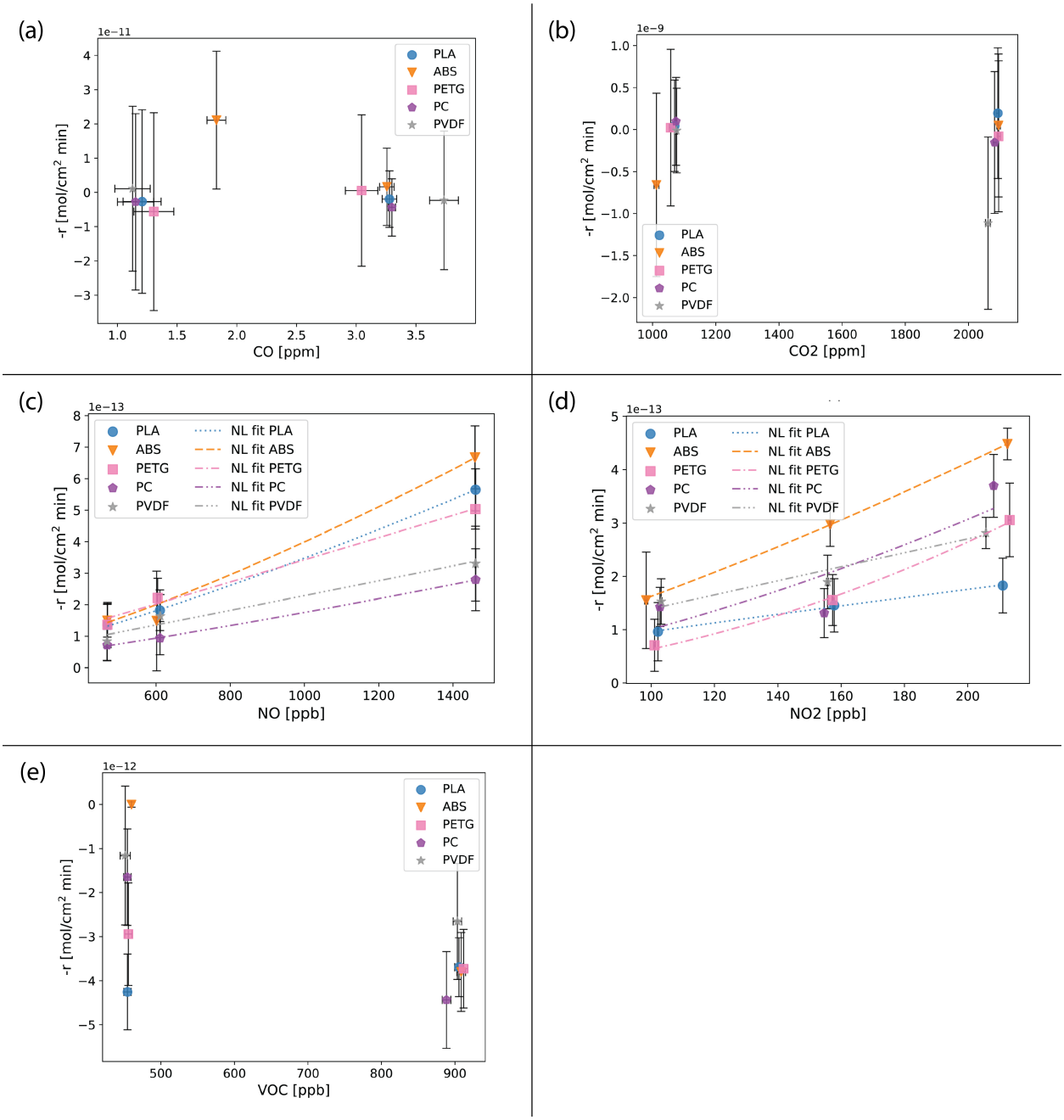

Figure S1: Reaction results converted to molar units for carbon monoxide (CO, a), carbon dioxide (CO_2, b), nitrogen monoxide (NO, c), nitrogen dioxide (NO_2, d), and volatile organic compounds (VOC, e) with the five thermoplastic materials - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF).

Figure S.2

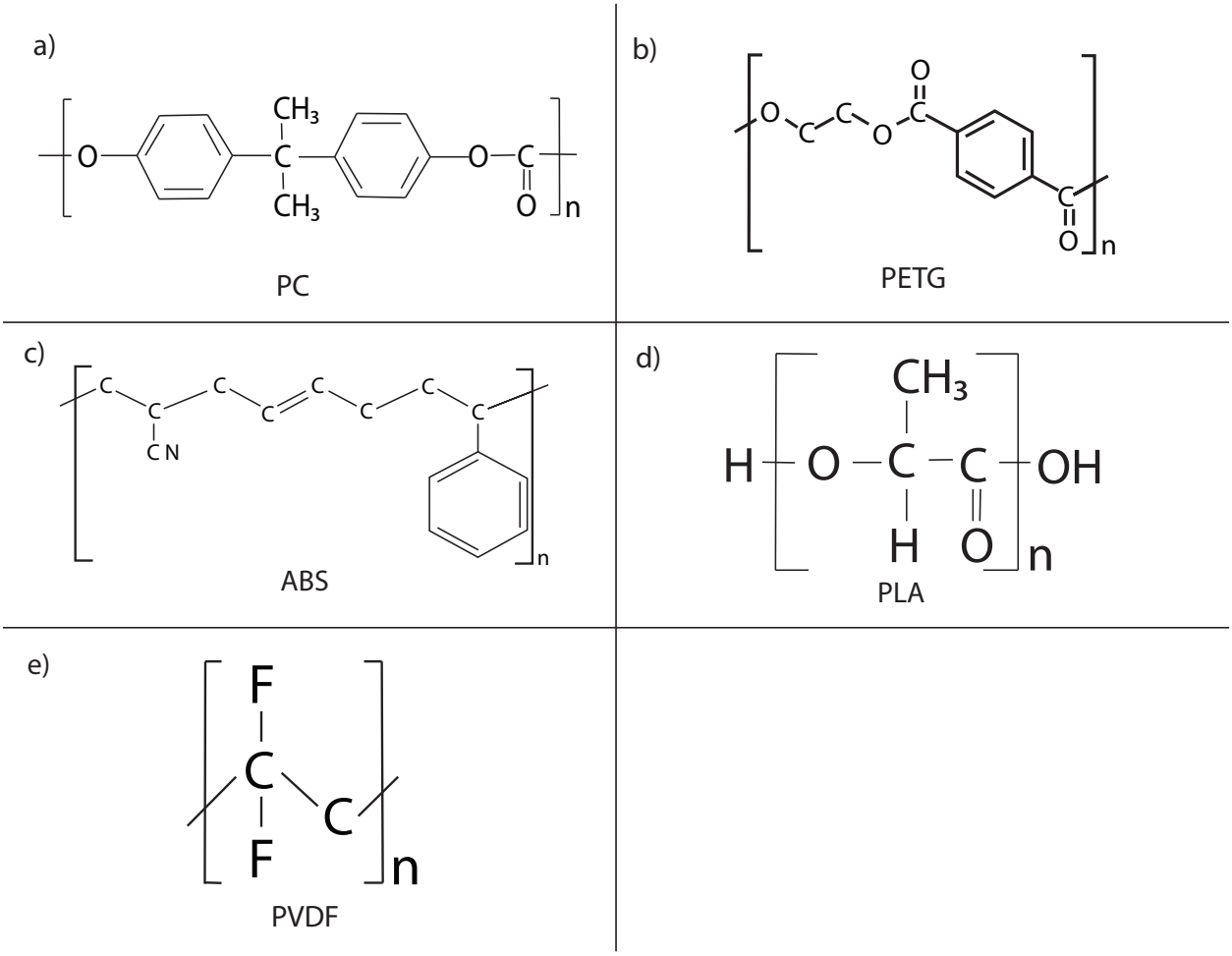

Figure S2: Chemical structures for polycarbonate (PC, a), polyethylene terephthalate glycol (PETG, b), acrylonitrile butadiene styrene (ABS, c), polylactic acid (PLA, d), and polyvinylidene fluoride (PVDF, e). The structures were adapted from references [12, 14, 13, 8, 4, 15, 11, 4, 3, 1, 9]. Pariskii et al.[10] listed polymer groups that are sensitive to NO_2. ABS contains nitrile groups and carbon-carbon double bonds[8, 4, 15] that are listed as sensitive to reactions with NO_2. However, PLA, PETG, PC, and PVDF do not have functional groups that are listed as sensitive to NO_2. PLA's main reactive group is the ester in the polymer backbone[11, 4, 3]. PETG contains carbonyl, ester, and aryl functional groups[14]. Aromatic PC polymer contains carbonate and aryl functional groups[12]. PVDF's main functional is a halogen[1, 9]

Figure S.3

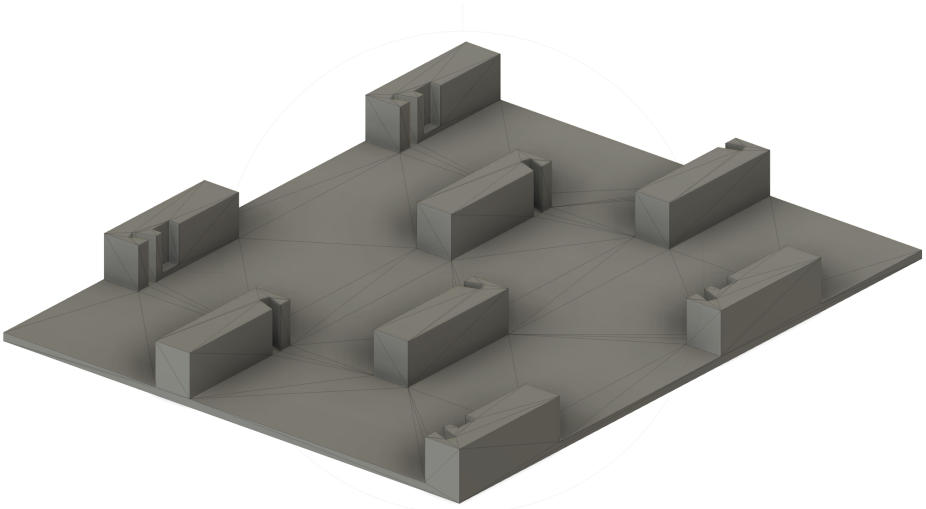

Figure S3: Screenshot of the baffle base plate designed in Fusion360.

Figure S.4

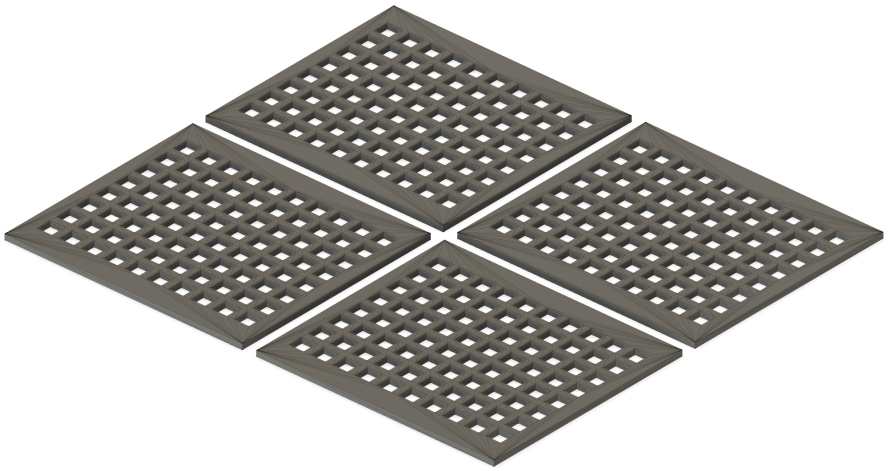

Figure S4: Screenshot of the vertical baffles designed in Fusion360.

Table S.1

Table S1: Off-gassing results for carbon monoxide (CO) and each of the five thermoplastic materials - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF). Off-gassing tests take place in a constant flow of zero air.

Date	Gas (Unit)	Material	F (±std)	SA (±std)	C_{SP}	C_{A0} (±std)	C_{A1} (±std)	ANOVA p-value	$-r_A$ (±error)	Molar $-r_A$ (±error)	T (±std)	RH (±std)
			(ccm)	(cm^2)	(ppm)	(ppm)	(ppm)		$\left(\frac{ccm*(ppm)}{cm^2}\right)$	$\left(\frac{mol}{cm^2*min}\right)$	(°C)	(%)
6/12/23	CO (ppm)	PLA	1100 (±1.12)	538.43 (±2.81)	0	0.01 (±0.04)	0.006 (±0.02)	0.127	0 (±0.14)	$3.47x10^{-13}$ ($\pm 5.82x10^{-12}$)	24.2 (±0)	10.52 (±0.23)
6/12/23	CO (ppm)	ABS	1100 (±1.12)	538.43 (±2.81)	0	0	0.001 (±0.01)	0.038	0 (±0.02)	$-1.20x10^{-13}$ ($\pm 9.96x10^{-13}$)	24.2 (±0)	10.56 (±0.22)
6/12/23	CO (ppm)	PETG	1100 (±1.12)	538.43 (±2.81)	0	0	0.002 (±0.01)	0.007	0 (±0.03)	$-1.99x10^{-13}$ ($\pm 1.28x10^{-12}$)	24.42 (±0.04)	10.67 (±0.31)
6/12/23	CO (ppm)	PC	1100 (±1.12)	538.43 (±5.62)	0	0	0		0	0	24.46 (±0.04)	9.41 (±0.28)
6/20/23	CO (ppm)	PVDF	1100 (±1.12)	538.43 (±5.62)	0	0.01 (±0.03)	0.04 (±0.05)	<0.001	-0.05 (±0.17)	$-2.18x10^{-12}$ ($\pm 7.13x10^{-12}$)	24.22 (±0.04)	8.71 (±0.07)

Column descriptions:
F - gas flowrate
SA - thermoplastic baffle surface area
C_{SP} - dilution system gas concentration set point
C_{A0} - baseline concentration measurements without the thermoplastic baffle in the acrylic chamber
C_{A1} - concentration measurements with the thermoplastic baffle in the acrylic chamber
ANOVA p-value - analysis of variance (ANOVA) p-value if the C_{A0} and C_{A1} concentration measurements have different averages. A p-value of <0.05 is considered statistically significant in this study.
$-r_A$ - calculated reaction rate according to Equation 3
Molar $-r_A$ - calculated reaction rate according to Equation 3 converted to molar units
T - average experiment temperature
RH - average experiment relative humidity

Table S.2

Table S2: Off-gassing results for carbon dioxide (CO_2) and each of the five thermoplastic materials - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF). Off-gassing tests take place in a constant flow of zero air.

Date	Gas (Unit)	Material	F (±std)	SA (±std)	C_{SP}	C_{A0} (±std)	C_{A1} (±std)	ANOVA p-value	$-r_A$ (±error)	Molar$-r_A$ (±error)	T (±std)	RH (±std)
			(ccm)	(cm^2)	(ppm)	(ppm)	(ppm)		$\left(\frac{ccm*(ppm)}{cm^2}\right)$	$\left(\frac{mol}{cm^2*min}\right)$	(°C)	(%)
6/7/23	CO_2 (ppm)	PLA	1100 (±1.12)	538.43 (±2.81)	0	0	0	N/A	0	0	24.43 (±0.04)	11.57 (±0.35)
6/7/23	CO_2 (ppm)	ABS	1100 (±1.12)	538.43 (±2.81)	0	0	0	N/A	0	0	24.52 (±0.04)	10.4 (±0.29)
6/7/23	CO_2 (ppm)	PETG	1100 (±1.12)	538.43 (±2.81)	0	0	0	N/A	0	0	24.43 (±0.05)	10.09 (±0.24)
6/7/23	CO_2 (ppm)	PC	1100 (±1.12)	538.43 (±5.62)	0	0	0	N/A	0	0	24.84 (±0.07)	9.61 (±0.23)
6/21/23	CO_2 (ppm)	PVDF	1100 (±1.12)	538.43 (±5.62)	0	0	0	N/A	0	0	23.93 (±0.04)	9.04 (±0.22)

Column descriptions:
F - gas flowrate
SA - thermoplastic baffle surface area
C_{SP} - dilution system gas concentration set point
C_{A0} - baseline concentration measurements without the thermoplastic baffle in the acrylic chamber
C_{A1} - concentration measurements with the thermoplastic baffle in the acrylic chamber
ANOVA p-value - analysis of variance (ANOVA) p-value if the C_{A0} and C_{A1} concentration measurements have different averages. A p-value of <0.05 is considered statistically significant in this study.
$-r_A$ - calculated reaction rate according to Equation 3
Molar $-r_A$ - calculated reaction rate according to Equation 3 converted to molar units
T - average experiment temperature
RH - average experiment relative humidity

Table S.3

Table S3: Off-gassing results for nitrogen monoxide (NO) and each of the five thermoplastic materials - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF). Off-gassing tests take place in a constant flow of zero air.

Date	Gas (Unit)	Material	F (±std)	SA (±std)	C_{SP}	C_{A0} (±std)	C_{A1} (±std)	ANOVA p-value	$-r_A$ (±error)	Molar$-r_A$ (±error)	T (±std)	RH (±std)
			(ccm)	(cm^2)	(ppb)	(ppb)	(ppb)		$\left(\frac{ccm*(ppb)}{cm^2}\right)\left(\frac{mol}{cm^2*min}\right)$		(°C)	(%)
7/6/23	NO (ppb)	PLA	1100 (±1.12)	538.43 (±2.81)	0	0.15 (±0.04)	0.18 (±0.03)	0.534	-0.05 (±0.16)	$-2.24x10^{-15}$ ($\pm 6.75x10^{-15}$)	24.88 (±0.08)	11.61 (±0.32)
7/6/23	NO (ppb)	ABS	1100 (±1.12)	538.43 (±2.81)	0	0.10 (±0.05)	0.15 (±0.06)	0.143	-0.1 (±0.26)	$-4.47x10^{-15}$ ($\pm 1.08x10^{-14}$)	24.92 (±0.07)	10.98 (±0.24)
7/6/23	NO (ppb)	PETG	1100 (±1.12)	538.43 (±2.81)	0	0.07 (±0.05)	0.06 (±0.03)	0.780	0.01 (±0.18)	$7.62x10^{-16}$ ($\pm 7.60x10^{-15}$)	25 (±0.01)	10.76 (±0.18)
7/6/23	NO (ppb)	PC	1100 (±1.12)	538.43 (±5.62)	0	0.04 (±0.02)	0.03 (±0.03)	0.503	0.02 (±0.13)	$1.07x10^{-15}$ ($\pm 5.51x10^{-15}$)	24.8 (±0)	8.83 (±0.05)
7/6/23	NO (ppb)	PVDF	1100 (±1.12)	538.43 (±5.62)	0	-0.03 (±0.01)	-0.15 (±0.05)	0.022	0.25 (±0.12)	$1.03x10^{-14}$ ($\pm 5.26x10^{-15}$)	25.26 (±0.07)	8.82 (±0.14)

Column descriptions:
F - gas flowrate
SA - thermoplastic baffle surface area
C_{SP} - dilution system gas concentration set point
C_{A0} - baseline concentration measurements without the thermoplastic baffle in the acrylic chamber
C_{A1} - concentration measurements with the thermoplastic baffle in the acrylic chamber
ANOVA p-value - analysis of variance (ANOVA) p-value if the C_{A0} and C_{A1} concentration measurements have different averages. A p-value of <0.05 is considered statistically significant in this study.
$-r_A$ - calculated reaction rate according to Equation 3
Molar $-r_A$ - calculated reaction rate according to Equation 3 converted to molar units
T - average experiment temperature
RH - average experiment relative humidity

Table S.4

Table S4: Off-gassing results for nitrogen dioxide (NO_2) and each of the five thermoplastic materials - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF). Off-gassing tests take place in a constant flow of zero air.

Date	Gas (Unit)	Material	F (±std)	SA (±std)	C_{SP}	C_{A0} (±std)	C_{A1} (±std)	ANOVA p-value	$-r_A$ (±error)	Molar $-r_A$ (±error)	T (±std)	RH (±std)
			(ccm)	(cm^2)	(ppb)	(ppb)	(ppb)		$\left(\frac{ccm*(ppb)}{cm^2}\right)$	$\left(\frac{mol}{cm^2*min}\right)$	(°C)	(%)
6/22/23	NO_2 (ppb)	PLA	1100 (±1.12)	538.43 (±2.81)	0	1.51 (±0.03)	1.61 (±0.06)	0.025	-0.2 (±0.2)	$-8.59x10^{-15}$ ($\pm 8.55x10^{-15}$)	24.45 (±0.05)	10.29 (±0.22)
6/22/23	NO_2 (ppb)	ABS	1100 (±1.12)	538.43 (±2.81)	0	1.56 (±0.03)	1.6 (±0.03)	0.150	-0.07 (±0.14)	$-3.05x10^{-15}$ ($\pm 5.83x10^{-15}$)	24.5 (±0.02)	9.85 (±0.23)
6/22/23	NO_2 (ppb)	PETG	1100 (±1.12)	538.43 (±2.81)	0	1.56 (±0.03)	1.58 (±0.04)	0.543	-0.03 (±0.16)	$-1.43x10^{-15}$ ($\pm 6.61x10^{-15}$)	24.64 (±0.05)	9.32 (±0.16)
6/22/23	NO_2 (ppb)	PC	1100 (±1.12)	538.43 (±5.62)	0	1.51 (±0.08)	1.57 (±0.08)	0.178	-0.12 (±0.35)	$-5.20x10^{-15}$ ($\pm 1.45x10^{-14}$)	24.6 (±0.01)	8.11 (±0.07)
6/22/23	NO_2 (ppb)	PVDF	1100 (±1.12)	538.43 (±5.62)	0	1.48 (±0.03)	1.52 (±0.04)	0.181	-0.07 (±0.14)	$-3.04x10^{-15}$ ($\pm 6.09x10^{-15}$)	24.7 (±0.02)	7.9 (±0.11)

Column descriptions:
F - gas flowrate
SA - thermoplastic baffle surface area
C_{SP} - dilution system gas concentration set point
C_{A0} - baseline concentration measurements without the thermoplastic baffle in the acrylic chamber
C_{A1} - concentration measurements with the thermoplastic baffle in the acrylic chamber
ANOVA p-value - analysis of variance (ANOVA) p-value if the C_{A0} and C_{A1} concentration measurements have different averages. A p-value of <0.05 is considered statistically significant in this study.
$-r_A$ - calculated reaction rate according to Equation 3
Molar $-r_A$ - calculated reaction rate according to Equation 3 converted to molar units
T - average experiment temperature
RH - average experiment relative humidity

Table S.5

Table S5: Off-gassing results for volatile organic compounds (VOC) and each of the five thermoplastic materials - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF). Off-gassing tests take place in a constant flow of zero air.

Date	Gas (Unit)	Material	F (±std)	SA (±std)	C_{SP}	C_{A0} (±std)	C_{A1} (±std)	ANOVA p-value	$-r_A$ (±error)	Molar $-r_A$ (±error)	T (±std)	RH (±std)
			(ccm)	(cm^2)	(ppb)	(ppb)	(ppb)		$\left(\frac{ccm*(ppb)}{cm^2}\right)$	$\left(\frac{mol}{cm^2*min}\right)$	(°C)	(%)
6/15/23	VOC (ppb)	PLA	1100 (±1.12)	538.43 (±2.81)	0	30 (±0)	38.95 (±3.06)	<0.001	-18.28 (±6.27)	$-7.50x10^{-13}$ ($\pm 2.57x10^{-13}$)	24.01 (±0.03)	10.86 (±0.2)
6/15/23	VOC (ppb)	ABS	1100 (±1.12)	538.43 (±2.81)	0	25.33 (±2.5)	40.38 (±1.91)	<0.001	-30.74 (±9.03)	$-1.26x10^{-12}$ ($\pm 3.70x10^{-13}$)	24.3 (±0.02)	10.35 (±0.23)
6/15/23	VOC (ppb)	PETG	1100 (±1.12)	538.43 (±2.81)	0	20.26 (±2.5)	30 (±0)	<0.001	-19.88 (±5.11)	$-8.15x10^{-13}$ ($\pm 2.10x10^{-13}$)	24.36 (±0.04)	10.15 (±0.22)
6/15/23	VOC (ppb)	PC	1100 (±1.12)	538.43 (±5.62)	0	19.93 (±1.15)	30.61 (±2.41)	<0.001	-21.83 (±7.28)	$-8.95x10^{-13}$ ($\pm 2.99x10^{-13}$)	24.64 (±0.05)	9.04 (±0.16)
6/15/23	VOC (ppb)	PVDF	1100 (±1.12)	538.43 (±5.62)	0	19.8 (±1.96)	20 (±0)	0.039	-0.4 (±4.01)	$-1.67x10^{-14}$ ($\pm 1.65x10^{-13}$)	24.43 (±0.04)	7.88 (±0.06)

Column descriptions:
F - gas flowrate
SA - thermoplastic baffle surface area
C_{SP} - dilution system gas concentration set point
C_{A0} - baseline concentration measurements without the thermoplastic baffle in the acrylic chamber
C_{A1} - concentration measurements with the thermoplastic baffle in the acrylic chamber
ANOVA p-value - analysis of variance (ANOVA) p-value if the C_{A0} and C_{A1} concentration measurements have different averages. A p-value of <0.05 is considered statistically significant in this study.
$-r_A$ - calculated reaction rate according to Equation 3
Molar $-r_A$ - calculated reaction rate according to Equation 3 converted to molar units
T - average experiment temperature
RH - average experiment relative humidity

Table S.6

Table S6: Reaction results for carbon monoxide (CO) and each of the five thermoplastic materials - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF). Two gas concentration tests were run for each of the five thermoplastic materials. A third concentration was not run since no-to-limited reaction was observed between CO and the thermoplastic materials.

Date	Gas (Unit)	Material	F (±std)	SA (±std)	C_{SP}	C_{A0} (±std)	C_{A1} (±std)	ANOVA p-value	$-r_A$ (±error)	Molar $-r_A$ (±error)	T (±std)	RH (±std)
			(ccm)	(cm^2)	(ppm)	(ppm)	(ppm)		$\left(\frac{ccm*(ppm)}{cm^2}\right)$	$\left(\frac{mol}{cm^2*min}\right)$	(°C)	(%)
7/12/23	CO (ppm)	PLA	1100 (±1.12)	538.43 (±2.81)	4	3.27 (±0.06)	3.3 (±0.03)	<0.001	-0.04 (±0.2)	$-1.95x10^{-12}$ ($\pm 8.25x10^{-12}$)	24.47 (±0.04)	10.48 (±0.23)
8/29/23	CO (ppm)	PLA	1100 (±1.12)	538.43 (±2.81)	2	1.2 (±0.15)	1.23 (±0.16)	0.027	-0.06 (±0.65)	$-2.67x10^{-12}$ ($\pm 2.68x10^{-11}$)	24.1 (±0.08)	12.94 (±0.25)
7/12/23	CO (ppm)	ABS	1100 (±1.12)	538.43 (±2.81)	4	3.25 (±0.06)	3.23 (±0.07)	0.008	0.03 (±0.27)	$1.63x10^{-12}$ ($\pm 1.13x10^{-11}$)	24.45 (±0.05)	9.58 (±0.18)
8/29/23	CO (ppm)	ABS	1100 (±1.12)	538.43 (±2.81)	2	1.82 (±0.08)	1.58 (±0.16)	<0.001	0.51 (±0.49)	$2.11x10^{-11}$ ($\pm 2.01x10^{-11}$)	23.59 (±0)	13.47 (±0.28)
7/12/23	CO (ppm)	PETG	1100 (±1.12)	538.43 (±2.81)	4	3.04 (±0.13)	3.03 (±0.12)	0.638	0.01 (±0.53)	$5.38x10^{-13}$ ($\pm 2.21x10^{-11}$)	24.45 (±0.05)	10.11 (±0.18)
8/29/23	CO (ppm)	PETG	1100 (±1.12)	538.43 (±2.81)	2	1.3 (±0.16)	1.37 (±0.17)	<0.001	-0.13 (±0.7)	$-5.60x10^{-12}$ ($\pm 2.89x10^{-11}$)	23.94 (±0.04)	12.69 (±0.19)
7/12/23	CO (ppm)	PC	1100 (±1.12)	538.43 (±5.62)	4	3.29 (±0.03)	3.35 (±0.06)	<0.001	-0.1 (±0.2)	$-4.38x10^{-12}$ ($\pm 8.37x10^{-12}$)	24.47 (±0.04)	9.63 (±0.16)
8/29/23	CO (ppm)	PC	1100 (±1.12)	538.43 (±5.62)	2	1.15 (±0.15)	1.18 (±0.15)	0.018	-0.06 (±0.62)	$-2.75x10^{\{-12\}}$ ($\pm 2.57x10^{-11}$)	24.07 (±0.06)	12.11 (±0.22)
6/20/23	CO (ppm)	PVDF	1100 (±1.12)	538.43 (±5.62)	4	3.73 (±0.12)	3.76 (±0.12)	0.123	-0.05 (±0.49)	$-2.33x10^{\{-12\}}$ ($\pm 2.02x10^{-11}$)	24.96 (±0.07)	8.47 (±0.22)
8/29/23	CO (ppm)	PVDF	1100 (±1.12)	538.43 (±5.62)	2	1.12 (±0.14)	1.11 (±0.13)	0.320	0.02 (±0.58)	$1.07x10^{-12}$ ($\pm 2.41x10^{-11}$)	24.2 (±0.01)	10.81 (±0.12)

Column descriptions:
F - gas flowrate
SA - thermoplastic baffle surface area
C_{SP} - dilution system gas concentration set point
C_{A0} - baseline concentration measurements without the thermoplastic baffle in the acrylic chamber
C_{A1} - concentration measurements with the thermoplastic baffle in the acrylic chamber
ANOVA p-value - analysis of variance (ANOVA) p-value if the C_{A0} and C_{A1} concentration measurements have different averages. A p-value of <0.05 is considered statistically significant in this study.
$-r_A$ - calculated reaction rate according to Equation 3
Molar $-r_A$ - calculated reaction rate according to Equation 3 converted to molar units
T - average experiment temperature
RH - average experiment relative humidity

Table S.7

Table S7: Reaction results for carbon dioxide (CO_2) and each of the five thermoplastic materials - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF). Two gas concentration tests were run for each of the five thermoplastic materials. A third concentration was not run since no-to-limited reaction was observed between CO_2 and the thermoplastic materials.

Date	Gas (Unit)	Material	F (±std)	SA (±std)	C_{SP}	C_{A0} (±std)	C_{A1} (±std)	ANOVA p-value	$-r_A$ (±error)	Molar$-r_A$ (±error)	T (±std)	RH (±std)
			(ccm)	(cm^2)	(ppm)	(ppm)	(ppm)		$\left(\frac{ccm*(ppm)}{cm^2}\right)$	$\left(\frac{mol}{cm^2*min}\right)$	(°C)	(%)
6/7/23	CO_2 (ppm)	PLA	1100 (±1.12)	538.43 (±2.81)	2000	2092.54 (±4.87)	2090.21 (±4.42)	<0.001	4.75 (±18.98)	$1.95x10^{-10}$ ($\pm 7.78x10^{-10}$)	24.98 (±0.04)	9.49 (±0.24)
8/31/23	CO_2 (ppm)	PLA	1100 (±1.12)	538.43 (±2.81)	1000	1070.09 (±3.32)	1069.55 (±3.17)	0.461	1.09 (±13.27)	$4.50x10^{-11}$ ($\pm 5.44x10^{-10}$)	24.69 (±0.06)	12.57 (±0.42)
6/7/23	CO_2 (ppm)	ABS	1100 (±1.12)	538.43 (±2.81)	2000	2094.87 (±5.5)	2094.29 (±4.65)	0.080	1.18 (±20.77)	$4.85x10^{-11}$ ($\pm 8.51x10^{-10}$)	24.78 (±0.03)	9.87 (±0.27)
8/31/23	CO_2 (ppm)	ABS	1100 (±1.12)	538.43 (±2.81)	1000	1012.4 (±7.9)	1020.28 (±5.13)	0.142	-16.08 (±26.62)	$-6.59x10^{-10}$ ($\pm 1.09x10^{-09}$)	24 (±N/A)	14 (±N/A)
6/7/23	CO_2 (ppm)	PETG	1100 (±1.12)	538.43 (±2.81)	2000	2095.36 (±5.5)	2096.32 (±5.21)	0.005	-1.95 (±21.9)	$-8.00x10^{-11}$ ($\pm 8.98x10^{-10}$)	24.91 (±0.07)	10.16 (±0.22)
8/31/23	CO_2 (ppm)	PETG	1100 (±1.12)	538.43 (±2.81)	1000	1057.37 (±3.97)	1057.1 (±7.15)	0.879	0.55 (±22.74)	$2.28x10^{-11}$ ($\pm 9.32x10^{-10}$)	24.52 (±0.04)	14.3 (±0.73)
6/7/23	CO_2 (ppm)	PC	1100 (±1.12)	538.43 (±5.62)	2000	2082.61 (±5.08)	2084.45 (±4.99)	0.001	-3.76 (±20.59)	$-1.54x10^{-10}$ ($\pm 8.44x10^{-10}$)	24.84 (±0.06)	8.58 (±0.17)
8/31/23	CO_2 (ppm)	PC	1100 (±1.12)	538.43 (±5.62)	1000	1074.16 (±3.16)	1073 (±3.08)	0.063	2.38 (±12.76)	$9.77x10^{-11}$ ($\pm 5.23x10^{-10}$)	24.41 (±0.03)	12.95 (±0.31)
6/21/23	CO_2 (ppm)	PVDF	1100 (±1.12)	538.43 (±5.62)	2000	2061.55 (±7.71)	2074.85 (±4.53)	<0.001	-27.18 (±25.02)	$-1.11x10^{-9}$ ($\pm 1.03x10^{-09}$)	24.4 (±0)	8.36 (±0.15)
8/31/23	CO_2 (ppm)	PVDF	1100 (±1.12)	538.43 (±5.62)	1000	1076.09 (±3.16)	1076.23 (±2.85)	0.793	-0.3 (±12.29)	$-1.24x10^{-11}$ ($\pm 5.04x10^{-10}$)	24.53 (±0.05)	12.88 (±0.43)

Column descriptions:
F - gas flowrate
SA - thermoplastic baffle surface area
C_{SP} - dilution system gas concentration set point
C_{A0} - baseline concentration measurements without the thermoplastic baffle in the acrylic chamber
C_{A1} - concentration measurements with the thermoplastic baffle in the acrylic chamber
ANOVA p-value - analysis of variance (ANOVA) p-value if the C_{A0} and C_{A1} concentration measurements have different averages. A p-value of <0.05 is considered statistically significant in this study.
$-r_A$ - calculated reaction rate according to Equation 3
Molar $-r_A$ - calculated reaction rate according to Equation 3 converted to molar units
T - average experiment temperature
RH - average experiment relative humidity

Table S.8

Table S8: Reaction results for nitrogen monoxide (NO) and each of the five thermoplastic materials - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF). Three gas concentration tests were run for each of the five thermoplastic materials since the initial two gas concentration tests for NO showed statistically significant NO reaction rates.

Date	Gas (Unit)	Material	F (±std)	SA (±std)	C_{SP}	C_{A0} (±std)	C_{A1} (±std)	ANOVA p-value	$-r_A$ (±error)	Molar $-r_A$ (±error)	T (±std)	RH (±std)
			(ccm)	(cm^2)	(ppb)	(ppb)	(ppb)		$\left(\frac{ccm*(ppb)}{cm^2}\right)$	$\left(\frac{mol}{cm^2*min}\right)$	(°C)	(%)
7/6/23	NO (ppb)	PLA	1100 (±1.12)	538.43 (±2.81)	1000	610.39 (±0.36)	608.22 (±0.4)	<0.001	4.44 (±1.57)	$1.82x10^{-13}$ ($\pm 6.46x10^{-14}$)	25.23 (±0.04)	9.82 (±0.14)
9/12/23	NO (ppb)	PLA	1100 (±1.12)	538.43 (±2.81)	500	468.75 (±0.52)	467.13 (±0.32)	<0.001	3.31 (±1.75)	$1.36x10^{-13}$ ($\pm 7.18x10^{-14}$)	23.2 (±0)	12.43 (±0.09)
10/24/23	NO (ppb)	PLA	1100 (±1.12)	538.43 (±2.81)	1500	1460.8 (±0.56)	1454.06 (±0.22)	<0.001	13.77 (±1.62)	$5.65x10^{-13}$ ($\pm 6.67x10^{-14}$)	24 (±N/A)	12 (±N/A)
7/7/23	NO (ppb)	ABS	1100 (±1.12)	538.43 (±2.81)	1000	601.47 (±1.28)	599.7 (±0.6)	0.183	3.62 (±3.85)	$1.49x10^{-13}$ ($\pm 1.58x10^{-13}$)	25.55 (±0.04)	10.2 (±0.22)
9/12/23	NO (ppb)	ABS	1100 (±1.12)	538.43 (±2.81)	500	468.32 (±0.33)	466.54 (±0.28)	<0.001	3.64 (±1.26)	$1.49x10^{-13}$ ($\pm 5.19x10^{-14}$)	23.5 (±0)	11.98 (±0.07)
10/24/23	NO (ppb)	ABS	1100 (±1.12)	538.43 (±2.81)	1500	1459.37 (±0.7)	1451.4 (±0.48)	<0.001	16.28 (±2.42)	$6.67x10^{-13}$ ($\pm 9.96x10^{-14}$)	23.84 (±0.04)	12.78 (±0.17)
7/7/23	NO (ppb)	PETG	1100 (±1.12)	538.43 (±2.81)	1000	604.28 (±0.39)	601.64 (±0.34)	<0.001	5.4 (±1.52)	$2.21x10^{-13}$ ($\pm 6.24x10^{-14}$)	25.9 (±0.08)	10.63 (±0.2)
9/12/23	NO (ppb)	PETG	1100 (±1.12)	538.43 (±2.81)	500	468.47 (±0.52)	466.84 (±0.27)	<0.001	3.32 (±1.64)	$1.36x10^{-13}$ ($\pm 6.75x10^{-14}$)	23.45 (±0.04)	12.29 (±0.07)
10/24/23	NO (ppb)	PETG	1100 (±1.12)	538.43 (±2.81)	1500	1460.44 (±0.36)	1454.42 (±0.39)	<0.001	12.28 (±1.55)	$5.04x10^{-13}$ ($\pm 6.38x10^{-14}$)	23.99 (±0.01)	12.19 (±0.11)
7/6/23	NO (ppb)	PC	1100 (±1.12)	538.43 (±5.62)	1000	610.62 (±0.36)	609.5 (±0.25)	<0.001	2.28 (±1.28)	$9.37x10^{-14}$ ($\pm 5.26x10^{-14}$)	25.28 (±0.06)	9.19 (±0.13)
9/12/23	NO (ppb)	PC	1100 (±1.12)	538.43 (±5.62)	500	467.89 (±0.19)	467.03 (±0.39)	<0.001	1.74 (±1.21)	$7.17x10^{-14}$ ($\pm 4.98x10^{-14}$)	23.72 (±0.08)	11.6 (±0.1)
10/24/23	NO (ppb)	PC	1100 (±1.12)	538.43 (±5.62)	1500	1461 (±0.56)	1457.67 (±0.6)	<0.001	6.81 (±2.39)	$2.79x10^{-13}$ ($\pm 9.82x10^{-14}$)	24.12 (±0.05)	11.15 (±0.09)
7/6/23	NO (ppb)	PVDF	1100 (±1.12)	538.43 (±5.62)	1000	611.34 (±0.34)	609.38 (±0.46)	<0.001	3.99 (±1.66)	$1.64x10^{-13}$ ($\pm 6.81x10^{-14}$)	25.38 (±0.07)	8.72 (±0.14)
9/12/23	NO (ppb)	PVDF	1100 (±1.12)	538.43 (±5.62)	500	467.5 (±0.26)	466.49 (±0.46)	<0.001	2.04 (±1.49)	$8.40x10^{-14}$ ($\pm 6.11x10^{-14}$)	23.6 (±0.02)	11.06 (±0.07)
10/24/23	NO (ppb)	PVDF	1100 (±1.12)	538.43 (±5.62)	1500	1460.78 (±0.82)	1456.83 (±0.58)	<0.001	8.05 (±2.89)	$3.30x10^{-13}$ ($\pm 1.19x10^{-13}$)	24.24 (±0.06)	10.6 (±0.11)

Column descriptions:
F - gas flowrate
SA - thermoplastic baffle surface area
C_{SP} - dilution system gas concentration set point
C_{A0} - baseline concentration measurements without the thermoplastic baffle in the acrylic chamber
C_{A1} - concentration measurements with the thermoplastic baffle in the acrylic chamber
ANOVA p-value - analysis of variance (ANOVA) p-value if the C_{A0} and C_{A1} concentration measurements have different averages. A p-value of <0.05 is considered statistically significant in this study.
$-r_A$ - calculated reaction rate according to Equation 3
Molar $-r_A$ - calculated reaction rate according to Equation 3 converted to molar units
T - average experiment temperature
RH - average experiment relative humidity

Table S.9

Table S9: Reaction results for nitrogen dioxide (NO_2) and each of the five thermoplastic materials - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF). Three gas concentration tests were run for each of the five thermoplastic materials since the initial two gas concentration tests for NO_2 showed statistically significant NO_2 reaction rates.

Date	Gas (Unit)	Material	F (±std)	SA (±std)	C_{SP}	C_{A0} (±std)	C_{A1} (±std)	ANOVA p-value	$-r_A$ (±error)	Molar $-r_A$ (±error)	T (±std)	RH (±std)
			(ccm)	(cm^2)	(ppb)	(ppb)	(ppb)		$\left(\frac{ccm*(ppb)}{cm^2}\right)$	$\left(\frac{mol}{cm^2*min}\right)$	(°C)	(%)
6/22/23	NO_2 (ppb)	PLA	1100 (±1.12)	538.43 (±2.81)	200	211.08 (±0.2)	208.9 (±0.41)	<0.001	4.46 (±1.25)	$1.83x10^{-13}$ ($\pm 5.13x10^{-14}$)	25 (±0)	9.2 (±0.17)
9/14/23	NO_2 (ppb)	PLA	1100 (±1.12)	538.43 (±2.81)	100	102.15 (±0.25)	101 (±0.4)	<0.001	2.34 (±1.33)	$9.62x10^{-14}$ ($\pm 5.46x10^{-14}$)	24.02 (±0.06)	13.55 (±0.35)
10/26/23	NO_2 (ppb)	PLA	1100 (±1.12)	538.43 (±2.81)	150	152.25 (±0.19)	149.96 (±0.3)	0.009	4.68 (±1.02)	$1.92x10^{-13}$ ($\pm 4.21x10^{-14}$)	24 (±N/A)	14 (±N/A)
6/22/23	NO_2 (ppb)	ABS	1100 (±1.12)	538.43 (±2.81)	200	212.54 (±0.2)	207.19 (±0.14)	<0.001	10.92 (±0.71)	$4.48x10^{-13}$ ($\pm 2.94x10^{-14}$)	25.25 (±0.06)	9.48 (±0.23)
9/14/23	NO_2 (ppb)	ABS	1100 (±1.12)	538.43 (±2.81)	100	98.44 (±0.49)	96.58 (±0.58)	0.054	3.78 (±2.2)	$1.55x10^{-13}$ ($\pm 9.05x10^{-14}$)	23.81 (±0.07)	13.94 (±0.41)
10/26/23	NO_2 (ppb)	ABS	1100 (±1.12)	538.43 (±2.81)	150	143.64 (±0.37)	142.98 (±0.53)	0.729	1.34 (±1.85)	$5.53x10^{-14}$ ($\pm 7.61x10^{-14}$)	24 (±N/A)	14 (±N/A)
6/22/23	NO_2 (ppb)	PETG	1100 (±1.12)	538.43 (±2.81)	200	213.25 (±0.46)	209.6 (±0.36)	<0.001	7.45 (±1.67)	$3.06x10^{-13}$ ($\pm 6.88x10^{-14}$)	25.28 (±0.06)	8.99 (±0.19)
9/14/23	NO_2 (ppb)	PETG	1100 (±1.12)	538.43 (±2.81)	100	101.07 (±0.29)	100.23 (±0.28)	0.038	1.72 (±1.19)	$7.07x10^{-14}$ ($\pm 4.88x10^{-14}$)	23.91 (±0.05)	14.62 (±5.82)
10/26/23	NO_2 (ppb)	PETG	1100 (±1.12)	538.43 (±2.81)	150	149.22 (±0.15)	147.83 (±0.41)	0.048	2.83 (±1.18)	$1.16x10^{-13}$ ($\pm 4.85x10^{-14}$)	24 (±N/A)	14 (±N/A)
6/22/23	NO_2 (ppb)	PC	1100 (±1.12)	538.43 (±5.62)	200	208.2 (±0.33)	203.79 (±0.36)	<0.001	9.01 (±1.43)	$3.70x10^{-13}$ ($\pm 5.88x10^{-14}$)	25.23 (±0.07)	8.74 (±1.39)
9/14/23	NO_2 (ppb)	PC	1100 (±1.12)	538.43 (±5.62)	100	102.79 (±0.29)	101.08 (±0.14)	<0.001	3.48 (±0.89)	$1.43x10^{-13}$ ($\pm 3.67x10^{-14}$)	24.17 (±0.07)	11.79 (±1.91)
10/26/23	NO_2 (ppb)	PC	1100 (±1.12)	538.43 (±5.62)	150	154.63 (±0.3)	153.07 (±0.24)	<0.001	3.2 (±1.12)	$1.31x10^{-13}$ ($\pm 4.60x10^{-14}$)	24 (±N/A)	14 (±N/A)
1/19/24	NO_2 (ppb)	PVDF	1100 (±1.12)	538.43 (±5.62)	200	205.76 (±0.14)	202.39 (±0.21)	0.009	6.87 (±0.71)	$2.81x10^{-13}$ ($\pm 2.93x10^{-14}$)	22.3 (±0)	14.8 (±0)
9/14/23	NO_2 (ppb)	PVDF	1100 (±1.12)	538.43 (±5.62)	100	103.17 (±0.29)	101.35 (±0.21)	<0.001	3.73 (±1.03)	$1.53x10^{-13}$ ($\pm 4.26x10^{-14}$)	24.27 (±0.08)	10.92 (±0.81)
10/26/23	NO_2 (ppb)	PVDF	1100 (±1.12)	538.43 (±5.62)	150	155.69 (±0.3)	153.43 (±0.29)	<0.001	4.62 (±1.22)	$1.89x10^{-13}$ ($\pm 5.03x10^{-14}$)	24 (±N/A)	14 (±N/A)

Column descriptions:
F - gas flowrate
SA - thermoplastic baffle surface area
C_{SP} - dilution system gas concentration set point
C_{A0} - baseline concentration measurements without the thermoplastic baffle in the acrylic chamber
C_{A1} - concentration measurements with the thermoplastic baffle in the acrylic chamber
ANOVA p-value - analysis of variance (ANOVA) p-value if the C_{A0} and C_{A1} concentration measurements have different averages. A p-value of <0.05 is considered statistically significant in this study.
$-r_A$ - calculated reaction rate according to Equation 3
Molar $-r_A$ - calculated reaction rate according to Equation 3 converted to molar units
T - average experiment temperature
RH - average experiment relative humidity

Table S.10

Table S10: Reaction results for volatile organic compounds (VOC) and each of the five thermoplastics - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF). Two gas concentration tests were run for each of the five thermoplastic materials. A third concentration was not run since both of the initial VOC concentration tests indicate off-gassing instead of reaction with each thermoplastic material.

Date	Gas (Unit)	Material	F (±std)	SA (±std)	C_{SP}	C_{A0} (±std)	C_{A1} (±std)	ANOVA p-value	$-r_A$ (±error)	Molar $-r_A$ (±error)	T (±std)	RH (±std)
			(ccm)	(cm^2)	(ppb)	(ppb)	(ppb)		$\left(\frac{ccm*(ppb)}{cm^2}\right)$	$\left(\frac{mol}{cm^2*min}\right)$	(°C)	(%)
7/15/23	VOC (ppb)	PLA	1100 (±1.12)	538.43 (±2.81)	800	905.5 (±5.82)	949.61 (±2.15)	<0.001	-90.13 (±16.3)	$-3.69x10^{-12}$ ($\pm 6.68x10^{-13}$)	24.71 (±0.03)	10.39 (±0.3)
9/5/23	VOC (ppb)	PLA	1100 (±1.12)	538.43 (±2.81)	400	454.55 (±5.06)	505.38 (±5.18)	<0.001	-103.83 (±20.95)	$-4.25x10^{-12}$ ($\pm 8.59x10^{-13}$)	24 (±0)	13.26 (±0.12)
7/15/23	VOC (ppb)	ABS	1100 (±1.12)	538.43 (±2.81)	800	908.5 (±5.8)	953.9 (±4.89)	<0.001	-92.76 (±21.84)	$-3.80x10^{-12}$ ($\pm 8.95x10^{-13}$)	24.62 (±0.04)	9.89 (±0.29)
1/26/23	VOC (ppb)	ABS	1100 (±1.12)	538.43 (±2.81)	400	460 (±0)	460.35 (±94.72)	<0.001	-0.07 (±1.48)	-2.97^{-15} ($\pm 6.07x10^{-14}$)	22.4(±0)	23.3 (±0)
7/15/23	VOC (ppb)	PETG	1100 (±1.12)	538.43 (±2.81)	800	911.8 (±5.8)	956.33 (±4.83)	<0.001	-90.98 (±21.72)	$-3.73x10^{-12}$ ($\pm 8.90x10^{-13}$)	24.71 (±0.06)	10.65 (±0.28)
9/5/23	VOC (ppb)	PETG	1100 (±1.12)	538.43 (±2.81)	400	455.68 (±5.06)	490.85 (±8.8)	<0.001	-71.84 (±28.34)	$-2.94x10^{-12}$ ($\pm 1.16x10^{-12}$)	23.75 (±0.07)	12.89 (±0.25)
7/15/23	VOC (ppb)	PC	1100 (±1.12)	538.43 (±5.62)	800	888.5 (±5.82)	941.47 (±7.26)	<0.001	-108.22 (±26.77)	$-4.44x10^{-12}$ ($\pm 1.10x10^{-12}$)	24.58 (±0.03)	9.22 (±0.24)
9/5/23	VOC (ppb)	PC	1100 (±1.12)	538.43 (±5.62)	400	454.41 (±5.03)	474.13 (±8.04)	<0.001	-40.28 (±26.74)	$-1.65x10^{-12}$ ($\pm 1.10x10^{-12}$)	23.74 (±0.05)	12.42 (±0.24)
7/15/23	VOC (ppb)	PVDF	1100 (±1.12)	538.43 (±5.62)	800	903.42 (±5.66)	935.14 (±10.03)	<0.001	-64.8 (±32.08)	$-2.66x10^{-12}$ ($\pm 1.32x10^{-12}$)	24.71 (±0.03)	8.27 (±0.18)
9/5/23	VOC (ppb)	PVDF	1100 (±1.12)	538.43 (±5.62)	400	451.36 (±6.96)	465.21 (±11.87)	<0.001	-28.3 (±38.49)	$-1.16x10^{-12}$ ($\pm 1.58x10^{-12}$)	23.89 (±0.06)	13.01 (±6.51)

Column descriptions:
F - gas flowrate
SA - thermoplastic baffle surface area
C_{SP} - dilution system gas concentration set point
C_{A0} - baseline concentration measurements without the thermoplastic baffle in the acrylic chamber
C_{A1} - concentration measurements with the thermoplastic baffle in the acrylic chamber
ANOVA p-value - analysis of variance (ANOVA) p-value if the C_{A0} and C_{A1} concentration measurements have different averages. A p-value of <0.05 is considered statistically significant in this study.
$-r_A$ - calculated reaction rate according to Equation 3
Molar $-r_A$ - calculated reaction rate according to Equation 3 converted to molar units
T - average experiment temperature
RH - average experiment relative humidity

Table S.11

Table S11: Sgnificance testing results for VOC off-gassing rates between each of the thermoplastics - polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polyethylene terephthalate glycol (PETG), polycarbonate (PC), and polyvinylidene fluoride (PVDF).

Materials	p-value	Adjusted α[1]
PLA and ABS	0.0001	0.0025
PLA and PETG	0.4419	0.0025
PLA and PC	0.1078	0.0025
PLA and PVDF	$8.422x10^{-6}$	0.0025
ABS and PLA	0.0018	0.0025
ABS and PETG	0.0042	0.0025
ABS and PC	0.0123	0.0025
ABS and PVDF	$2.169x10^{-6}$	0.0025
PETG and PLA	0.3497	0.0025
PETG and ABS	$8.722x10^{-5}$	0.0025
PETG and PC	0.2596	0.0025
PETG and PVDF	$7.470x10^{-7}$	0.0025
PC and PLA	0.1589	0.0025
PC and ABS	0.0038	0.0025
PC and PETG	0.4205	0.0025
PC and PVDF	$6.565x10^{-6}$	0.0025
PVDF and PLA	$1.956x10^{-5}$	0.0025
PVDF and ABS	$1.89x10^{-8}$	0.0025
PVDF and PETG	$9.321x10^{-6}$	0.0025
PVDF and PC	$4.062x10^{-6}$	0.0025

[1] Bonferoni correction

Table S.12

Table S12: Nitrogen monoxide (NO) and nitrogen dioxide (NO_2) kinetic equation, Equation 2, nonlinear fit parameters.

Gas (Unit)	Material	k [CI]	α [CI]
		$[ccm * ppb/cm^2 * ppb^{\alpha}]$	[-]
NO (ppb)	PLA	$1.24x10^{-3}$ [$8.24x10^{-4}$, $1.63x10^{-3}$]	1.28 [1.23, 1.32]
NO (ppb)	ABS	$8.52x10^{-4}$ [$-5.21x10^{-4}$, $2.23x10^{-3}$]	1.35 [1.13, 1.58]
NO (ppb)	PETG	$6.88x10^{-3}$ [$-4.52x10^{-3}$, $1.83x10^{-2}$]	1.03 [0.79, 1.26]
NO (ppb)	PC	$9.35x10^{-4}$ [$4.75x10^{-4}$, $1.39x10^{-3}$]	1.22 [1.15, 1.29]
NO (ppb)	PVDF	$4.63x10^{-3}$ [$-1.17x10^{-2}$, $2.10x10^{-2}$]	1.03 [0.51, 1.54]
NO_2 (ppb)	PLA	$4.31x10^{-2}$ [$1.89x10^{-2}$, $6.74x10^{-2}$]	0.87 [0.75, 0.98]
NO_2 (ppb)	ABS	$8.10x10^{-3}$ [$6.19x10^{-3}$, $1.00x10^{-2}$]	1.35 [1.30, 1.39]
NO_2 (ppb)	PETG	$1.61x10^{-4}$ [$6.71x10^{-5}$, $3.00x10^{-4}$]	2.06 [1.76, 2.37]
NO_2 (ppb)	PC	$1.51x10^{-3}$ [$-1.47x10^{-2}$, $1.77x10^{-2}$]	1.61 [-0.48, 3.69]
NO_2 (ppb)	PVDF	$4.02x10^{-2}$ [$-5.34x10^{-2}$, $1.34x10^{-1}$]	0.96 [0.51, 1.41]

Table S.13

Table S13: Nitrogen monoxide (NO) and nitrogen dioxide (NO_2) kinetic equation, Equation 2, nonlinear fit parameters converted to molar units.

Gas (Unit)	Material	k_1 [CI][1]	α [CI][2]
		$\left[\frac{mol}{cm^2 * min * mol^{\alpha}}\right]$	[-]
NO (ppb)	PLA	$5.06x10^{-17}$ [$3.45x10^{-17}$, $6.68x10^{-17}$]	1.28 [1.23, 1.32]
NO (ppb)	ABS	$3.49x10^{-17}$ [$-2.14x10^{-17}$, $9.12x10^{-17}$]	1.35 [1.13, 1.58]
NO (ppb)	PETG	$2.82x10^{-16}$ [$-1.85x10^{-16}$, $7.49x10^{-16}$]	1.03 [0.79, 1.26]
NO (ppb)	PC	$3.83x10^{-17}$ [$1.95x10^{-17}$, $5.71x10^{-17}$]	1.22 [1.15, 1.29]
NO (ppb)	PVDF	$1.90x10^{-16}$ [$-4.85x10^{-16}$, $8.61x10^{-16}$]	1.03 [0.51, 1.54]
NO_2 (ppb)	PLA	$1.77x10^{-15}$ [$7.71x10^{-16}$, $2.76x10^{-15}$]	0.87 [0.75, 0.98]
NO_2 (ppb)	ABS	$3.32x10^{-16}$ [$2.54x10^{-16}$, $4.10x10^{-16}$]	1.35 [1.30, 1.39]
NO_2 (ppb)	PETG	$4.75x10^{-18}$ [$-2.75x10^{-18}$, $1.23x10^{-17}$]	2.06 [1.76, 2.37]
NO_2 (ppb)	PC	$6.20x10^{-17}$ [$-6.03x10^{-16}$, $7.27x10^{-16}$]	1.61 [-0.48, 3.69]
NO_2 (ppb)	PVDF	$1.65x10^{-16}$ [$-2.19x10^{-15}$, $5.48x10^{-15}$]	0.96 [0.51, 1.41]

[1] The optimal reaction rate constant parameter for the molar nonlinear fit is the same as the regular optimal reaction rate constant parameters except that it includes the conversion factors to go from $ccm*ppb$ to mol. $-r_A = \frac{k}{(10^9)(24.4)(1000)} C_A^{\alpha} = k_1 C_A^{\alpha}$.

[2] The optimal reaction order parameter for the molar nonlinear fit is the same as the regular optimal reaction order parameter.

Table S.14

Table S14: FDM thermoplastic housing component impact on trace gas concentrations for VOC, NO, and NO_2 in a 2800 cm^3 enclosure with a fan that draws air through the housing at a rate of 83,333 ccm resulting in a 2-second gas residence time or 2,222 ccm resulting in a gas residence time of 75 seconds. Using FDM-printed thermoplastic inserts with a total surface area of 118 cm^2.

Gas	Material	Concentration[1]	α	k	$-r_A$	Range of Flow Rates	Surface Area	Range in Amount of Gas Off-gassed | Reacted Range	Range in Percent Difference of Concentration
		(ppb)	(-)	$\left(\frac{ccm*ppb}{cm^2*ppb^{\alpha}}\right)$	$\left(\frac{ccm*ppb}{cm^2}\right)$	(ccm)	(cm^2)	(ppb)	
VOC	PLA	41	N/A	N/A	-18.29	2,222 to 83,333	118	$-2.59x10^{-2}$ to $-9.71x10^{-1}$	$6.31x10^{-2}$ to 2.37 %
VOC	ABS	41	N/A	N/A	-30.74	2,222 to 83,333	118	$-4.35x10^{-2}$ to -1.63	$1.06x10^{-1}$ to 3.98 %
VOC	PETG	41	N/A	N/A	-19.88	2,222 to 83,333	118	$-2.81x10^{-2}$ to -1.06	$6.87x10^{-2}$ to 2.57 %
VOC	PC	41	N/A	N/A	-21.83	2,222 to 83,333	118	$-3.09x10^{-2}$ to -1.16	$7.54x10^{-2}$ to 2.83 %
VOC	PVDF	41	N/A	N/A	-0.41	2,222 to 83,333	118	$-5.78x10^{-4}$ to $-2.17x10^{-2}$	$1.41x10^{-3}$ to $5.29x10^{-2}$ %
NO	PLA	35	1.28	$1.24x10^{-3}$	0.117	2,222 to 83,333	118	$1.65x10^{-4}$ to $6.19x10^{3}$	$4.71x10^{-4}$ to $1.77x10^{-2}$ %
NO	ABS	35	1.35	$8.52x10^{-4}$	0.105	2,222 to 83,333	118	$1.48x10^{-4}$ to $5.55x10^{-3}$	$4.23x10^{-4}$ to $1.59x10^{-2}$ %
NO	PETG	35	1.03	$6.88x10^{-3}$	0.266	2,222 to 83,333	118	$3.77x10^{-4}$ to $1.41x10^{-2}$	$1.08x10^{-3}$ to $4.03x10^{-3}$ %
NO	PC	35	1.22	$9.35x10^{-4}$	0.072	2,222 to 83,333	118	$1.01x10^{-4}$ to $3.80x10^{-3}$	$2.89x10^{-4}$ to $1.09x10^{-2}$ %
NO	PVDF	35	1.03	$4.63x10^{-3}$	0.178	2,222 to 83,333	118	$2.53x10^{-4}$ to $9.47x10^{-3}$	$7.22x10^{-4}$ to $2.71x10^{-2}$ %
NO_2	PLA	35	0.87	$4.31x10^{-2}$	0.944	2,222 to 83,333	118	$2.13x10^{-3}$ to $7.98x10^{-2}$	$6.08x10^{-3}$ to $2.28x10^{-1}$ %
NO_2	ABS	35	1.35	$8.10x10^{-3}$	0.966	2,222 to 83,333	118	$1.41x10^{-5}$ to $5.28x10^{-4}$	$4.02x10^{-5}$ to $1.51x10^{-3}$ %
NO_2	PETG	35	2.06	$1.16x10^{-4}$	0.177	2,222 to 83,333	118	$1.58x10^{-4}$ to $5.94x10^{-3}$	$4.52x10^{-4}$ to $1.70x10^{-2}$ %
NO_2	PC	35	1.61	$1.51x10^{-3}$	0.456	2,222 to 83,333	118	$6.46x10^{-4}$ to $2.42x10^{-2}$	$1.85x10^{-3}$ to $6.92x10^{-2}$ %
NO_2	PVDF	35	0.96	$4.02x10^{-2}$	1.23	2,222 to 83,333	118	$9.45x10^{-4}$ to $3.54x10^{-2}$	$2.70x10^{-3}$ to $1.01x10^{-1}$ %

[1] Preliminary work for the planned study showed an average VOC concentration of 40 ppb with a max of 1000 ppb from roadside measurements of some idling vehicles. Liu et al. [5] measured vehicle emission in parking garages and found the peak hourly averaged NOx measurement of approximately 35 ppb at the center of the parking garage and 10 ppb at the gate of the parking garage. Therefore, a 40 ppb VOC concentration and 35 ppb NO/NO2 concentrations were used as the theoretical concentrations to estimate the impact of the FDM-printed thermoplastic structural supports in this theoretical exercise.

Column descriptions:

α - reaction experiment result nonlinear fit parameter for reaction order

k - reaction experiment result nonlinear fit parameter for reaction rate constant

$-r_A$ - For NO and NO_2, calculated reaction rate according to Equation 2. For VOC, estimated off-gassing rate from off-gassing experiment results.

Table S.15

Table S15: Worst case FDM thermoplastic housing component impact on trace gas concentrations for VOC, NO, and NO_2. This scenario includes lower VOC concentrations but higher NO and NO_2 concentrations. With a larger thermoplastic surface area assuming both the 2800 cm^3 enclosure (1360 cm^2 surface area) and the inserts (118 cm^2) are FDM-printed thermoplastics.

Gas	Material	Concentration	α	k	$-r_A$	Range of Flow Rates[1]	Surface Area	Range in Amount of Gas Off-gassed | Reacted Range	Range in Percent Difference of Concentration
		(ppb)	(-)	$\left(\frac{ccm*ppb}{cm^2*ppb^{\alpha}}\right)$	$\left(\frac{ccm*ppb}{cm^2}\right)$	(ccm)	(cm^2)	(ppb)	
VOC	PLA	10	N/A	N/A	-18.29	2,222 to 83,333	1478	-0.324 to -12.2	3.24 to 122 %
VOC	ABS	10	N/A	N/A	-30.74	2,222 to 83,333	1478	-0.545 to -20.4	5.45 to 204 %
VOC	PETG	10	N/A	N/A	-19.88	2,222 to 83,333	1478	-0.353 to -13.2	3.53 to 132 %
VOC	PC	10	N/A	N/A	-21.83	2,222 to 83,333	1478	-0.387 to -14.5	3.87 to 145 %
VOC	PVDF	10	N/A	N/A	-0.41	2,222 to 83,333	1478	$-7.25x10^{-3}$ to -0.272	$7.25x10^{-2}$ to 2.72 %
NO	PLA	600	1.28	$1.24x10^{-3}$	4.41	2,222 to 83,333	1478	$7.83x10^{-2}$ to 7.05	$1.30x10^{-2}$ to 1.17 %
NO	ABS	600	1.35	$8.52x10^{-4}$	4.88	2,222 to 83,333	1478	$8.66x10^{-2}$ to 7.79	$1.44x10^{-2}$ to 1.3 %
NO	PETG	600	1.03	$6.88x10^{-3}$	4.94	2,222 to 83,333	1478	$8.76x10^{-2}$ to 7.88	$1.46x10^{-2}$ to 1.31 %
NO	PC	600	1.22	$9.35x10^{-4}$	2.29	2,222 to 83,333	1478	$4.07x10^{-2}$ to 3.66	$6.78x10^{-3}$ to 0.61 %
NO	PVDF	600	1.03	$4.63x10^{-3}$	3.30	2,222 to 83,333	1478	$5.86x10^{-2}$ to 5.27	$9.77x10^{-3}$ to 0.879 %
NO_2	PLA	200	0.87	$4.31x10^{-2}$	4.29	2,222 to 83,333	1478	$7.60x10^{-2}$ to 2.85	$3.80x10^{-2}$ to 1.43 %
NO_2	ABS	200	1.35	$8.10x10^{-3}$	10.1	2,222 to 83,333	1478	0.179 to 6.70	$8.94x10^{-2}$ to 3.35 %
NO_2	PETG	200	2.06	$1.16x10^{-4}$	6.46	2,222 to 83,333	1478	0.115 to 4.29	$5.73x10^{-2}$ to 2.15 %
NO_2	PC	200	1.61	$1.51x10^{-3}$	7.49	2,222 to 83,333	1478	0.113 to 4.98	$6.64x10^{-2}$ to 2.49 %
NO_2	PVDF	200	0.96	$4.02x10^{-2}$	6.60	2,222 to 83,333	1478	0.117 to 4.39	$5.85x10^{-2}$ to 2.19 %

[1] For a sensor housing with a volume of 2800 cm^3, a flow rate of 2,222.2 ccm produces a gas residence time of 75 seconds, while a flow rate of 83,333.3 ccm produces a gas residence time of 2 seconds.

Column descriptions:

α - reaction experiment result nonlinear fit parameter for reaction order

k - reaction experiment result nonlinear fit parameter for reaction rate constant

$-r_A$ - For NO and NO_2, calculated reaction rate according to Equation 2. For VOC, estimated off-gassing rate from off-gassing experiment results.

Section S.1: FDM-printed Baffle Surface Area Calculation and Uncertainty

The surface area calculation for the FDM-printed baffle was based on CAD models. Measurements were made within the CAD software, Fusion360, to calculate the expected surface area for the printed baffle. Uncertainty was added to the surface area calculation using the "print precision" obtained from documentation for the FlashForge Creator Pro 2 [2] and LulzBot TAZ 6 [6] printers.

The expression used to calculate the FDM-printed baffle surface area combines the surface area of the base

$$SA_{base} = w_{base}l_{base} + 16w_{out}h_{out} + 16h_{out}l_{out} + 8w_{out}l_{out} \tag{S1}$$

and the surface area of the vertical baffles

$$SA_{baffle} = 2l_{baffle}h_{baffle} + 2l_{bafffle}w_{baffle} + 2w_{baffle}h_{baffle} - 80w_{void}^2 + 32h_{baffle}w_{void} \tag{S2}$$

into the final surface area for the assembled baffle

$$SA = SA_{base} + SA_{baffles} = 538.43cm^2. \tag{S3}$$

Where SA is the calculated surface area of the assembled baffle, SA_{base} and SA_{baffle} are the calculated surface areas of the base and baffles that combine into the baffle assembly, and l, w, and h are the length, width, and height of either the base or the baffle as annotated. Equation 1 neglects the surfaces of the base that are in contact with the bottom or side walls of the acrylic chamber. Resulting in an assembled baffle surface area of 538.43 cm^2.

The uncertainty of the assembled baffle surface area was also calculated by combining the uncertainty in the surface area of the base

$$e_{base} = \sqrt{\sigma^2[(l_{base})^2 + (16h_{out} + 8l_{out})^2 + (w_{base})^2 + (16w_{out} + 16l_{out})^2 + (16h_{out} + 8w_{out})^2]} \tag{S4}$$

and the uncertainty in the surface area of the vertical baffles

$$e_{baffle} = \sqrt{\begin{aligned}&\sigma^2[(2h_{baffle} + 2w_{baffle})^2 + (2l_{baffle} + 2w_{baffle})^2 \\ &+(2l_{baffle} + 2w_{baffle} + 32w_{void})^2 + (-160w_{void} + 32h_{baffle})^2]\end{aligned}} \tag{S5}$$

into the final uncertainty in the surface area for the assembled baffle

$$e_{SA} = e_{base} + e_{vertical} = 2.81cm^2(FlashForge)\ or\ 5.62cm^2(LulzBot). \tag{S6}$$

Where e_{SA} is the calculated uncertainty for the assembled baffle surface area, e_{base} and e_{baffle} are the calculated uncertainties for the base surface area and baffle surface, σ is the "print precision" for either the FlashForge Creator 2 Pro or the LulzBot TAZ6, and l, w, and h are the length, width, and height of either the base or the baffle as annotated. Resulting in an assembled baffle surface area uncertainty of 2.81 cm^2 for the FlashForge Creator 2 Pro and 5.62 cm^2 for the LulzBot TAZ6.

Section S.2: Volumetric Flow Rate Uncertainty Calculation

Uncertainty in the dilution system total volumetric flow rate is determined based on the standard deviation of measured volumetric flow rates for each mass flow controller (MFC). The volumetric flow rate error is calculated by summing the standard deviations for each MFC

$$e_F = \sigma_{MFC_1} + \sigma_{MFC_2} + \sigma_{MFC_3} = 1.12ccm. \tag{S7}$$

Where e_F is the uncertainty in the volumetric flow rate, $\sigma_{MFC_\#}$ is the standard deviation of the measured volumetric flow rates for each MFC.

Section S.3: Equipment List

- NO and NO_2 Reference sensor: ThermoFisher NOx Analyzer Model 42i Part Number: 101350-00
- CO and CO_2 Reference sensor: TSI Q-TRAK Indoor Air Quality Monitor Model 7575 with Probe 982
- VOC Reference sensor: TSI Q-TRAK Indoor Air Quality Monitor Model 7575 with Probe 984
- Zero Air Generator: Teledyne High-Performance Zero Air Generator-Model T701H
- Mass Flow Controllers: MasterFlex Model Number 32907-67
- Temperature and Relative Humidity sensor: Aosong DHT22
- Microcontroller: Arduino Nano ATmega328
- High Temperature 3D printer: LulzBot TAZ 6
- 3D printer: FlashForge Creator Pro 2 EN-AO1
- Filaments:
  - ABS: HATCHBOX Model Number-3D ABS-1KG1.75-WHT. CAS number: 9003-56-9
  - PC: PolyMaker Polylite PC Model Number-PC01001. CAS number: 25037-45-0
  - PETG: HATCHBOX Model Number-3D PETG-1KG1.75-BLK. CAS number: 25640-14-6
  - PLA: HATCHBOX Model Number-3D PLA-1KG1.75-WHT. CAS number: 26100-51-6
  - PVDF: FLOURX Model Number-PVD01UN100750NAT0. CAS number: 24937-79-9
- Gasses:
  - Zero Air: AirGas Part Number: UN1002
  - Carbon monoxide: GASCO Part Number: 103L-50-500
  - Carbon dioxide: AirGas Part Number: UN1956
  - Nitrogen monoxide: GASCO Part Number: 116L-125-20
  - Nitrogen dioxide: GASCO Part Number: 116L-111-10
  - Isobutylene(for VOC reaction experiments): MESA Part Number: U105520PA

Section S.4: VOC Off-gassing Results Null Hypothesis Significance Testing

A null hypothesis significance test (NHST) was conducted to determine if there was a statistically significant difference between VOC off-gassing experiment reaction rates among each of the thermoplastics. The reaction rate result for each thermoplastic is a single calculated value with a single calculated estimated error value that were used to calculate the t-statistic for the NHST. The null hypothesis was defined as:

$$H_0 : -r_{A_{plasticX}} = -r_{A_{plasticY}}, \tag{S8}$$

and the t-statistic was calculated using:

$$t_{statistic} = \frac{-r_{A_{plasticX}} - (-r_{A_{plasticY}})}{e_{-r_{A_{plasticX}}}/\sqrt{N}}. \tag{S9}$$

Where $-r_{A_{plasticX}}$ and $-r_{A_{plasticY}}$ are the reaction rates for the thermoplastics that are being compared; $e_{-r_{A_{plasticX}}}$ is the estimated error in the reaction rate; and N is the number of concentration measurements used to calculate the reaction rate.

The t-statistic was converted to a p-value using the survival function, "scipy.stats.t.sf," with degrees of freedom as an input argument to the method. Additionally, a Bonferoni correction was applied to create an adjusted significance level ($\alpha_{adjusted}$) since a total of 20 NHST were conducted at once between each thermoplastic.

$$\alpha_{adjusted} = \frac{0.05}{20} = 0.0025 \tag{S10}$$

Table S11 lists the results for the VOC off-gassing NHST.

Section S.5: FDM-printed Baffle Design and FDM Printer Settings

The FDM-printed baffles were designed in Fusion360 computer aided design software. The baffle structure was designed in two pieces: a 9.3 cm x 11.5 cm x 0.15 cm base plate and four 6.5 cm x 5.8 cm x 0.15 cm vertical baffles. Each vertical baffle was covered with 80 evenly spaced 0.4 cm x 0.4 cm holes. The base plate design included inserts to mount the four vertical baffles, with two baffles aligned at 20-degree inward angles on each side. Figure S.S3 shows a screenshot of the base plate created in Fusion360. Figure S.S4 shows a screenshot of the vertical baffles created in Fusion360. The final baffle assembly was created by sliding the vertical baffles into the inserts of the base plate.

FlashPrint 5 slicing software was used for the baffles printed using the FlashForge Creator Pro 2 printer, while Cura LulzBot edition slicing software was used for the LulzBot TAZ6 printer. Both FDM printers, FlashForge Creator Pro 2 and LulzBot TAZ6, were set to print the baffles with a 15% infill and four layers for the shell for each thermoplastic. Additional settings for each thermoplastic were:

- ABS (FlashForge Creator Pro 2)
  - Extrusion temperature: 240°C
  - Bed temperature: 50°C
  - All other print parameters were left as default.
- PLA (FlashForge Creator Pro 2)
  - Extrusion temperature: 240°C
  - Bed temperature: 50°C
  - All other print parameters were left as default.
- PETG (FlashForge Creator Pro 2)
  - Extrusion temperature: 240°C
  - Bed temperature: 50°C
  - All other print parameters were left as default.
- PC (LulzBot TAZ6)
  - Extrusion temperature: 280°C
  - Bed temperature: 110°C
  - All other print parameters were left as default.
- PVDF (LulzBot TAZ6)
  - Extrusion temperature: 280°C
  - Bed temperature: 110°C
  - All other print parameters were left as default.
  - When printing with PVDF filament, the Lulzbot TAZ6 printer was placed inside a gas hood due to possible fluorine emissions [7].

Section S.6: Supplementary Material References

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