Environmental Evaluation of Chemical Plastic Waste Recycling: A Life Cycle Assessment Approach

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Table S1. Normalized inventory data according to chemical recycling of 1000 kg of plastics

PRE-TREATMENT		
Input		
Polyethylene	500	kg
Polypropylene	250	kg
Polystyrene	250	kg
Electricity	15.9	kWh
Output		
Plastic waste	1000	kg
FUEL PRODUCTION		
Input		
Plastic waste	1000	kg
Nitrogen	1751	kg
Electricity	409.9	kWh
Output		
Char	69.4	kg
Pyrolytic gas	2681	kg
POST-TREATMENT		
Input		
Pyrolytic gas	2681	kg
Char	69.4	kg
Output		
Char	0.0639	kg
Condensable gas	967	kg
Pyrolisis oil	1087	l
Non condensable gas	77.9	kg
Air	2860	kg
Moisture	2310	kg

Table S2. Comparison data between 1 liter of pyrolysis oil and 1 liter of fossil diesel

IMPACT CATEGORIES	UNIT	PYROLYSIS OIL	FOSSIL DIESEL	REDUCTION
ATMOSPHERICAL EFFECTS				
Global Warming	kg CO_2 eq	3.28×10^{-2}	5.59×10^{-1}	94.13%
Stratospheric Ozone Depletion	kg CFC11 eq	4.12×10^{-8}	7.33×10^{-7}	94.38%
Ionizing Radiation	kBq Co-60 eq	1.28×10^{-2}	2.10×10^{-2}	39.05%
Ozone Formation, Human Health	kg NOx eq	5.56×10^{-5}	1.93×10^{-3}	97.12%
Fine Particulate Matter Formation	kg $PM_{2.5}$ eq	9.15×10^{-6}	2.01×10^{-4}	95.45%
Ozone Formation, Terrestrial Ecosystems	kg NOx eq	5.57×10^{-5}	1.93×10^{-3}	97.11%
Terrestrial Acidification	kg SO_2 eq	8.27×10^{-5}	4.14×10^{-3}	98.00%
EUTROPHICATION				
Freshwater Eutrophication	kg P eq	6.32×10^{-6}	1.81×10^{-4}	96.51%
Marine Eutrophication	kg N eq	7.19×10^{-7}	4.17×10^{-6}	82.76%
TOXICITY				
Terrestrial Ecotoxicity	kg 1,4-DCB	3.13×10^{-3}	3.13×10^{-1}	99.00%
Freshwater Ecotoxicity		6.08×10^{-5}	5.73×10^{-4}	89.39%
Marine Ecotoxicity		2.77×10^{-5}	4.19×10^{-4}	93.39%
Human Carcinogenic Toxicity		4.27×10^{-6}	7.55×10^{-5}	94.34%
Human Non-Carcinogenic Toxicity		2.70×10^{-4}	7.46×10^{-4}	63.81%
ABIOTIC RESOURCES				
Land Use	m^2a crop eq	1.11×10^{-2}	5.15×10^{-2}	78.45%
Mineral Resource Scarcity	kg Cu eq	1.35×10^{-4}	6.74×10^{-4}	79.97%
Fossil Resource Scarcity	kg oil eq	4.01×10^{-3}	1.16×10^{0}	99.65%
Water Consumption	m^3	3.2×10^{-2}	1.2×10^{-3}	-2589.08%

Table S3. Comparative results of the scenario analysis. S1: Chemical recycling, S2: Landfill, S3: Incineration. Data related to the treatment of 1000 kg of input material

Impact categories	Unit	S1	S2	S3
ATMOSPHERICAL EFFECTS				
Global Warming	kg CO_2 eq	–3,849.61	408.65	–2,650.95
Stratospheric Ozone Depletion	kg CFC11 eq	-2.38×10^{-4}	4.72×10^{-5}	-8.71×10^{-4}
Ionizing Radiation	kBq Co–60 eq	–22.40	-	-
Ozone Formation, Human Health	kg NOx eq	–5.27	0.16	–7.40
Fine Particulate Matter Formation	kg $PM_{2.5}$ eq	–0.88	-	-
Ozone Formation, Terrestrial Ecosystems	kg NOx eq	–5.28	0.16	–7.40
Terrestrial Acidification	kg SO_2 eq	–7.37	0.17	–22.95
EUTROPHICATION				
Freshwater Eutrophication	kg P eq	–0.59	-	-
Marine Eutrophication	kg N eq	–0.07	-	-
TOXICITY				
Terrestrial Ecotoxicity	kg 1,4-DCB	–58.94	-	-
Freshwater Ecotoxicity		–2.27	-	-
Marine Ecotoxicity		–1.00	-	-
Human Carcinogenic Toxicity		– 0.44	-	-
Human Non–Carcinogenic Toxicity		–6.00	-	-
ABIOTIC RESOURCES				
Land Use	m^2a crop eq	– 174.89	-	-
Mineral Resource Scarcity	kg Cu eq	–2.84	0.27	–0.89
Fossil Resource Scarcity	kg oil eq	–1,807.56	14.84	–1,046.35
Water Consumption	m^3	–13.92	-	-