

Supplementary Information:

Table A1: Life cycle inventory of hexavalent chromium waste removal

FU=functional unit (1 kg chromium metal recovered)

Chromium Waste Treatment Stage			Process used	Notes
<i>Pre-treatment</i>				
Screening	kg/FU	kW/FU		
Concrete	0.0125432		Concrete, normal {CH} unreinforced concrete production, with cement CEM II/B APOS, U; Concrete, high exacting requirements {CH} concrete production, for building construction, with cement CEM II/B APOS, U	3% reinforcement was applied and allocated to high exacting requirements. The process "Inert waste, for final disposal {CH} market for inert waste, for final disposal APOS, U" was used for all concrete/construction waste treatment.
Steel	0.0002726		Steel, chromium steel 18/8 {RER} steel production, converter, chromium steel 18/8 APOS, U	
Energy const.		0.0001103	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV GB S	
<i>Balancing</i>				
	kg/FU	kW/FU		
Concrete	0.2686278		Concrete, normal {CH} unreinforced concrete production, with cement CEM II/B APOS, U; Concrete, high exacting requirements {CH} concrete production, for building construction, with cement CEM II/B APOS, U	
Energy const.		0.002192	Electricity mix, AC, consumption mix, at consumer, 1kV - 60kV GB S	
Pump material (Cast iron)	0.0011376		Cast iron {RER} production APOS, U	

Operations pump		0.343257	Electricity, high voltage {GB} production mix APOS, U
Anolyte feed prep	kg/FU	kW/FU	
Concrete	0.0189399		Concrete, normal {CH} unreinforced concrete production, with cement CEM II/B APOS, U; Concrete, high exacting requirements {CH} concrete production, for building construction, with cement CEM II/B APOS, U
Steel mixer	0.0039155		Steel, chromium steel 18/8 {RER} steel production, converter, chromium steel 18/8 APOS, U
Tank Pumps material (Cast iron)	0.0017		Cast iron {RER} production APOS, U
Energy const.		0.0003859	Electricity grid mix 1kV-60kV, AC, consumption mix, at consumer, 1kV - 60kV GB S
Operations		0.4676139	Electricity, high voltage {GB} production mix APOS, U
Catholyte feed prep	kg/FU	kW/FU	
Concrete	0.0021325		Concrete, normal {CH} unreinforced concrete production, with cement CEM II/B APOS, U; Concrete, high exacting requirements {CH} concrete production, for building construction, with cement CEM II/B APOS, U
Steel mixer	0.0011101		Steel, chromium steel 18/8 {RER} steel production, converter, chromium steel 18/8 APOS, U
Energy const.		0.000085	Electricity grid mix 1kV-60kV, AC, consumption mix, at consumer, 1kV - 60kV GB S
Tank Pump material (Cast iron)	0.0014		Cast iron {RER} production APOS, U

Operations		0.1170081	Electricity, high voltage {GB} production mix APOS, U	
Chemical(HCl)	1.42		Hydrochloric acid, without water, in 30% solution state {RER} market for APOS, U	
MFC reactor MoC	kg/FU	kW/FU		
Encasing	0.84		Polymethyl methacrylate, sheet {RER} production APOS, U	
Membrane	0.0026		Tetrafluoroethylene {RER} production APOS, U	
Anode (Carbon fibre)	0.162		Polyacrylonitrile fibres (PAN), from acrylonitrile and methacrylate, prod. mix, PAN w/o additives EU-27 S; Electricity, high voltage {GB} electricity production, natural gas, combined cycle power plant APOS, U; Transport, freight, lorry 7.5-16 metric ton, EURO5 {RER} transport, freight, lorry 7.5-16 metric ton, EURO5 APOS, U	losses in manufacturing was assumed to be the same for all the electrodes
Cathode (Carbon fibre)	0.162		Polyacrylonitrile fibres (PAN), from acrylonitrile and methacrylate, prod. mix, PAN w/o additives EU-27 S; Electricity, high voltage {GB} electricity production, natural gas, combined cycle power plant APOS, U; Transport, freight, lorry 7.5-16 metric ton, EURO5 {RER} transport, freight, lorry 7.5-16 metric ton, EURO5 APOS, U	

Electrode carbon brush	0.162		Graphite {GLO} market for APOS, U; Petroleum coke {GLO} market for APOS, U; Zinc {GLO} market for APOS, U; Polyphenylene sulfide {GLO} market for APOS, U; Extrusion, plastic pipes {RER} production APOS, U	Process energy for plastic extrusion was utilised for brush.
Electrode surfacing	0.0042345		Polymethyl methacrylate, sheet {RER} production APOS, U	Input in simapro was combined with carbon fibre production from PAN
Cell component	0.0051962		Polymethyl methacrylate, sheet {RER} production APOS, U	
Current collector	0.12		Titanium, primary {GLO} market for APOS, U	
Current collector	0.12		Copper {RER} production, primary APOS, U	
Electrode heat treatment		0.0357845	Electricity, high voltage {GB} production mix APOS, U	
Chemicals:H2O2	0.3371495		Hydrogen peroxide, without water, in 50% solution state {RER} hydrogen peroxide production, product in 50% solution state APOS, U	
Chemicals:H2SO4 (0.5 M)	0.4255059		Sulfuric acid, at plant/kg/RNA	
Water: De-ionised water	0.291703		Water, deionised, from tap water, at user {Europe without Switzerland} water production, deionised, from tap water, at user APOS, U	
Chemicals: Acetone	0.1828838		Acetone, liquid {RER} production APOS, U	
Waste treatment	0.0290141		Sewage sludge {GLO} market for Conseq, U	
Avoided Electricity		4.4	Electricity, high voltage {GB} production mix APOS, U	

Chromium metal recovery unit	kg/FU			
Tank material (PVC)	0.7559196		Polyvinyl chloride resin, at plant/RNA; Polyethylene, high density, granulate {CH} polyethylene, high density, granulate, recycled to generic market for high density PE granulate APOS, U; Blow moulding {GLO} market for APOS, U; Steel, chromium steel 18/8, hot rolled {RER} production APOS, U	The assumed recycled content-high density polyethylene (HDPE) was used in place of PVC, while virgin PVC remains unchanged
Chemicals: FeOH or NaOH	1.1236257		Sodium hydroxide, without water, in 50% solution state {RER} chlor-alkali electrolysis, diaphragm cell APOS, U	
Chromium metal recovered	1		Chromium {RER} production APOS, U	Assumed for recovered metal
End of Life (EoL) for process materials	kg/FU			
Total MoC waste	7.31		Mixed plastics (waste treatment) {GLO} recycling of mixed plastics APOS, U; Waste polyethylene, for recycling, sorted {Europe without Switzerland} treatment of waste polyethylene, for recycling, unsorted, sorting APOS, U; Polyethylene, high density, granulate, recycled {Europe without Switzerland} polyethylene production, high density, granulate, recycled APOS, U	A net scrap approach was used for some of the materials specifically PVC as it has the highest percentage share of the waste and better data on recycling and product information. Waste PE data was also used in some instances as reference material for the plastic components.