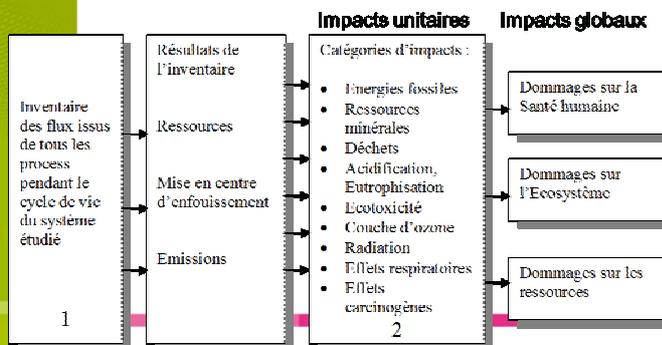


Analyse environnementale de la technologie de traçage pour le recyclage des polymères
E. Maris - ARTS et METIERS
Laboratoire Conception de Produits et Innovation

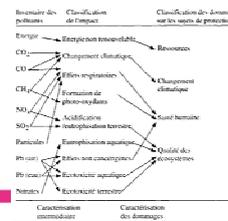
TRIPTIC (ANR / Ecotech 2009)
Séminaire de restitution - 4 février 2014

Principe de l'analyse environnementale de cycle de vie

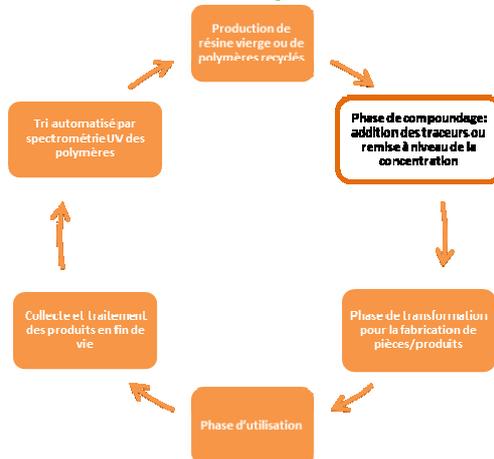
- Référence (JOLLIET, O. et Al, 2005)
- Outil d'ACV : SIMAPRO
- Méthode d'évaluation des impacts : Impact 2002



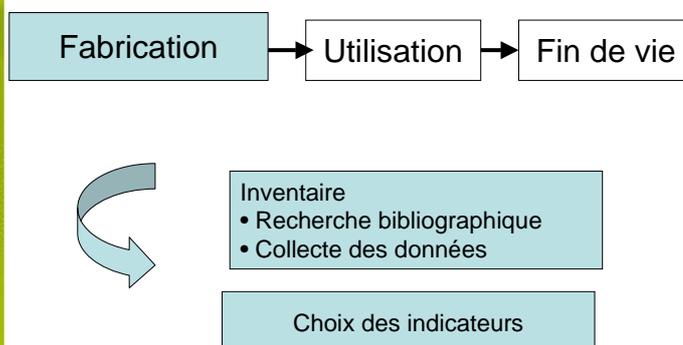
Catégorie d'impact	Unité
Carcinogens	kg C2H3Cl eq
Non-carcinogens	kg C2H3Cl eq
Respiratory inorganics	kg PM2.5 eq
Ionizing radiation	Bq C-14 eq
Ozone layer depletion	kg CFC-11 eq
Respiratory organics	kg C2H4 eq
Aquatic ecotoxicity	kg TEG water
Terrestrial ecotoxicity	kg TEG soil
Terrestrial acid/nutri	kg SO2 eq
Land occupation	m ² org. arable
Aquatic acidification	kg SO2 eq
Aquatic eutrophication	kg PO4 P-lim
Global warming	kg CO2 eq
Non-renewable energy	MJ primary
Mineral extraction	MJ surplus



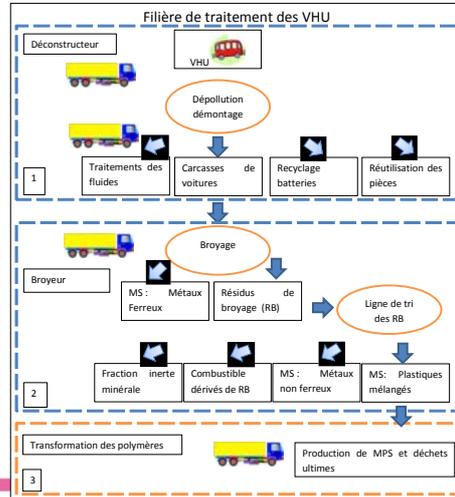
Recyclage et traçage des matériaux pour le tri : Principe



Périmètre de calcul



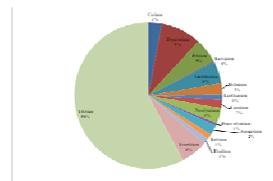
Modélisation plastiques recyclés issus de la filière VHU



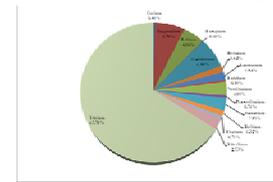
Traceurs à base de terres rares : Ressources connues, catégories de minerais, pays (2011 USGS)

Rare earth	Bastnaesite			Monazite			
	Mountain Pass, C.A., United States ¹	Bayan Obo, Inner Mongolia, China ²	North Capet, Western Australia ³	North Stradbroke Island, Queensland, Australia ²	Green Cove Springs, FL, United States ⁴	Nangang, Guangdong, China ²	
Cerium	40.10	50.00	46.00	45.80	43.70	42.70	
Dysprosium	trace	0.1	0.7	0.60	0.9	0.3	
Erbium	trace	trace	0.2	0.2	trace	0.1	
Europium	0.1	0.2	0.053	0.8	0.16	0.1	
Gadolinium	0.2	0.7	1.49	1.80	6.60	2.00	
Hoium	trace	trace	0.053	0.1	0.11	0.12	
Lanthanum	33.20	25.00	23.90	21.50	17.50	23.00	
Lucentium	trace	trace	trace	0.01	trace	0.14	
Neodymium	12.00	18.50	17.40	18.60	17.50	17.00	
Praseodymium	4.24	6.20	5.80	5.30	5.00	4.10	
Samarium	0.3	0.8	2.53	2.10	4.90	3.00	
Terbium	trace	0.1	0.035	0.3	0.26	0.7	
Thulium	trace	trace	trace	trace	trace	trace	
Ytterbium	trace	trace	0.1	0.1	0.71	2.40	
Yttrium	0.16	trace	2.40	2.50	2.20	2.40	
Total	100	100	100	100	100	100	

Rare earth	Monazite - Continued		Xenotime		Rare earth laterite	
	Eastern coast, Brazil ⁵	Mount Weld, Australia ⁶	Lahat, Perak, Malaysia ⁷	Southeast Guangdong, China ⁸	Xianwu, Jiangxi Province, China ⁹	Longnan, Jiangxi Province, China ¹⁰
Cerium	47.00	51.00	3.13	3.00	2.40	0.4
Dysprosium	0.4	0.2	8.30	9.10	trace	6.70
Erbium	0.1	0.2	6.40	5.60	trace	4.90
Europium	0.1	0.4	trace	0.2	0.5	0.10
Gadolinium	1.80	1.00	3.50	5.80	3.80	6.90
Hoium	trace	0.1	2.00	2.60	trace	1.60
Lanthanum	24.00	26.00	1.24	1.20	43.4	1.82
Lucentium	not determined	trace	1.00	1.80	0.1	0.4
Neodymium	18.50	15.00	1.60	3.50	31.70	3.60
Praseodymium	4.20	4.00	0.5	0.6	9.00	0.7
Samarium	3.00	1.80	1.10	2.20	3.90	2.80
Terbium	0.1	0.1	0.9	1.20	trace	1.30
Thulium	trace	trace	1.10	1.30	trace	0.7
Ytterbium	0.02	0.1	6.80	6.80	0.2	2.50
Yttrium	1.40	trace	61.00	58.50	8.00	65.00
Total	100	100	100	100	100	100

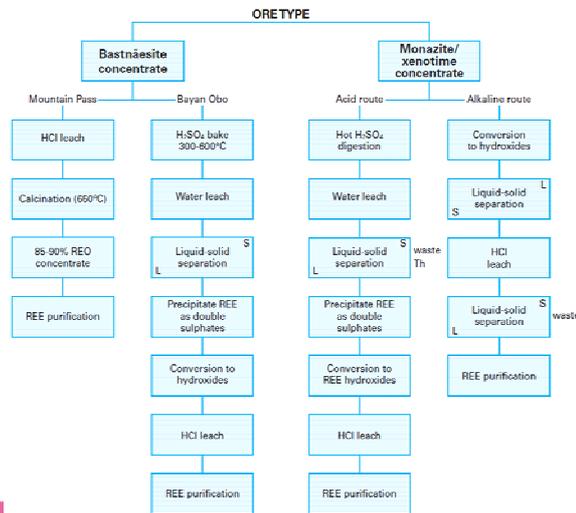


xenotime de Guangdong



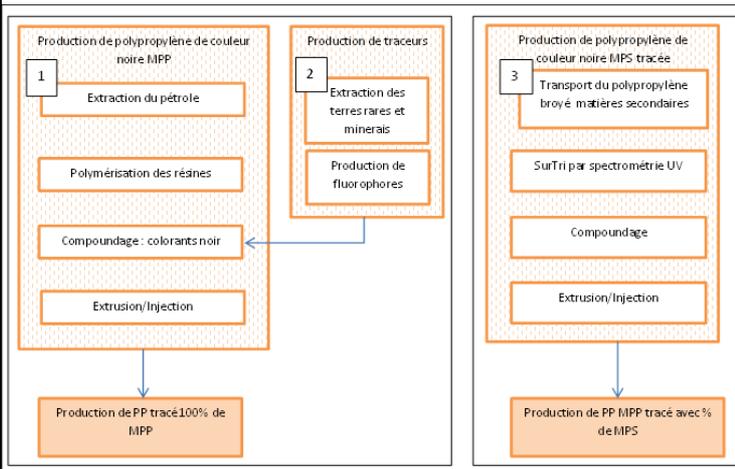
argiles latéritiques de Longnan

Procédés d'extraction des terres rares



Le recyclage des lampes basse consommation et des DEEE UMICORE, RHODIA?

Les limites du système étudié, Unité fonctionnelle et scénarios



UF= Production de 1kg de granulés de polypropylène de couleur sombre additivé de traceurs, pour des applications automobiles comme le pare choc.

Phase d'inventaire

Données bibliographiques

- Extractive metallurgy of rare earths C. K. Gupta and N. Krishnamurthy
- Life Cycle Assessment of Product Stewardship Options for Mercury-Containing Lamps in New Zealand: Final Report Published by Peter Garrett and Michael Collins, Environmental Resources Management (ERM), for the Ministry for the Environment (2009)
- Kinetics on leaching rare earth from the weathered crust elution-deposited rare earth ores with ammonium sulfate solution, Tian Jun, Yin Jingqun , Chi Ruan , Rao Guohua , Jiang Mintao , Ouyang Kexian
- Rapport de l'UNEP

Données ECOINVENT

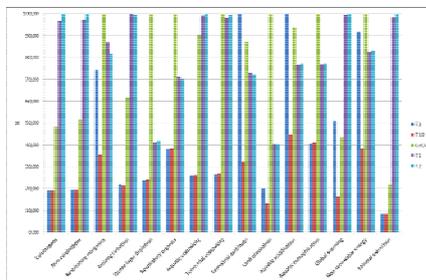
Données ARTS et METIERS

Environmental benefits provided by the recovery of plastics from shredding of automobiles

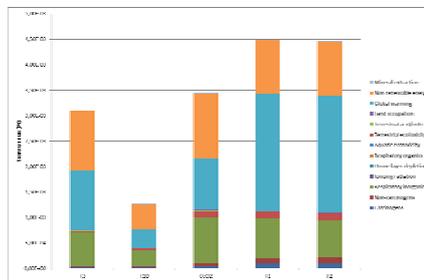
Daniel Froelich, Elisabeth Maris, Hugues de Feraudy, Ingo Soppe, Wolfgang Hang , Edited by FRAY INTERNATIONAL SYMPOSIUM, 2011

Comparaison des traceurs (1kg)

Caractérisation



Score unique



Conclusion

- Fiabilité des données
- Choix des traceurs
- Choix PP vierge versus recyclé

AGENCE NATIONALE DE LA RECHERCHE
ANR

TRIPTIC (ANR / Ecotech 2009)
Traceurs répartis pour identification des polymères et tri industriel en cadence
Distributed tracers for polymer materials identification & industrial sorting in cadence

Séminaire de restitution - 4 février 2014

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