Supplementary Materials

Adding value to waste minerals in a circular economy framework: Ochre derived layered double hydroxide catalysts in fatty acid ketonization

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12-tricosanone calibration curve

The 12-tricosanone calibration curve was prepared as follows:

A standard 0.05 M solution of 12-tricosanone was prepared and different dilutions were done, reducing the concentration of the latter as observed in Figure S1 as well as a 0.1M solution of the internal standard, Eicosane.

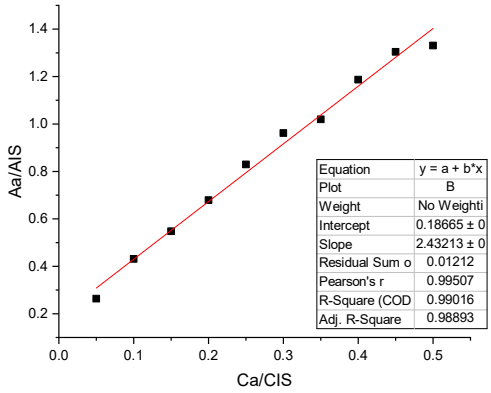

Figure S1. 12-tricosaone calibration curve. The ketone yield was estimated according to the following calibration curve, using a 0.1 M solution of Eicosane as the internal standard. Different concentration of a 12-tricosanone solution were prepared diluting a 0.5 M solution.

Dewatering analysis of Saltburn ochre

Dewatering analysis of the waste material Saltburn ochre was performed as observed in Table S1. The amount of water present in the sample was important to the stoichiometric calculations to find the appropriate concentration of iron in the sample and use the appropriate amount of Mg for the preparation of the catalyst.

Table S1. Dewatering analysis of Saltburn ochre samples at constant temperature of 60 °C.

Mass of wet ochre (g)	Mass of dry ochre	Weight Loss (%)
5.6493	1.1591	79.5
6.0755	1.3878	77.2
6.4830	1.4390	77.8
	Average	78.2

ICP-OES analysis of LDH-CO_3

The ICP analysis of the LDH-CO_3 scanned for a whole range of metals, as showed in Table S2. According to the technician in charge of the instrument, for semi-quantitative analysis of most elements the instrument scans across the electromagnetic spectrum from 190 to 800nm. The emission lines recorded are then processed with the 'Image' software, which compares them with those in its library to identify and quantify the elements present in the sample

Table S2. All metals present in 15 mg of LDH-CO_3 according to ICP-OES analysis.

LDH-CO_3	Element	Concentration (ppm)
	Ni	0.06
	Tm	0.06
	K	0.74
	Nb	0.08
	Dy	0.1
	Y	0.07
	Rh	0.15
	Er	0.06
	Cu	0.06
	Ga	0.21
	Rb	0.31
	Cd	0.14
	V	0.2
	As	0.07
	Gd	0.14
	Pr	0.24
	Zn	0.22
	Se	0.29
	La	0.53
	Nd	0.28
	Sr	0.55
	Na	0.57
	Mn	0.62
	Tc	0.53
	Tb	0.77
	Ba	0.94
	Mg	260
	Si	7.7
	Ca	15
	Fe	220
	Re	0.09
	W	0.45
	Os	0.15
	Ir	0.07
	Pt	0.08
	Pb	0.14
	Bi	0.06
	U	0.73

Catalyst characterization

The PXRD diffraction peaks from a calcined Saltburn ochre sample at 800 °C were used to prove right the data plotted in the TGA graphs, to help to interpret the loss of mass within the Saltburn ochre samples, which was related to the dehydroxilation of the latter, transforming all the FeO(OH) (goethite) into Fe_2O_3 while, at the same time, comparing the results with the existing literature.

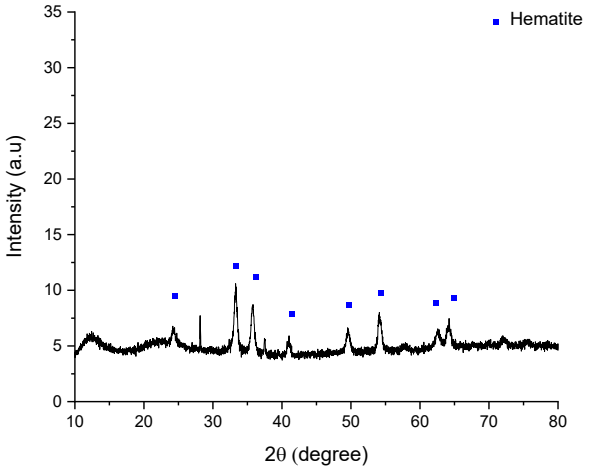

Figure S2. PXRD patter of calcined ochre at 800 °C. The sample was calcined for 3 hours under in a muffle.

Ketonic decarboxylation reactions

Ketone yield percentage was calculated using standards of 12-tricosanone and eicosane. As no other appreciable peaks were observed in the crude product mixture than those related to 12-tricosanone (See Figure S1) it was assumed no side reactions and full selectivity towards the ketone product was happening. The screening of the synthetic LDH (SLDH-CO_3) at 300 °C is presented in Table S3.

Table S3. Ketone yield using the (SLDH-CO_3) at 300 °C.

	300 ˚C			**250 ˚C**	
Catalyst load % (LDH-CO_3)	Ketone yield (%)	Catalyst load % (SLDH-CO_3)	Ketone yield (%)	Catalyst load % (LDH-CO_3)	Ketone yield (%)
1	68	1	47	1	0.5
3	81	3	86	3	8
5	70	5	74	5	24

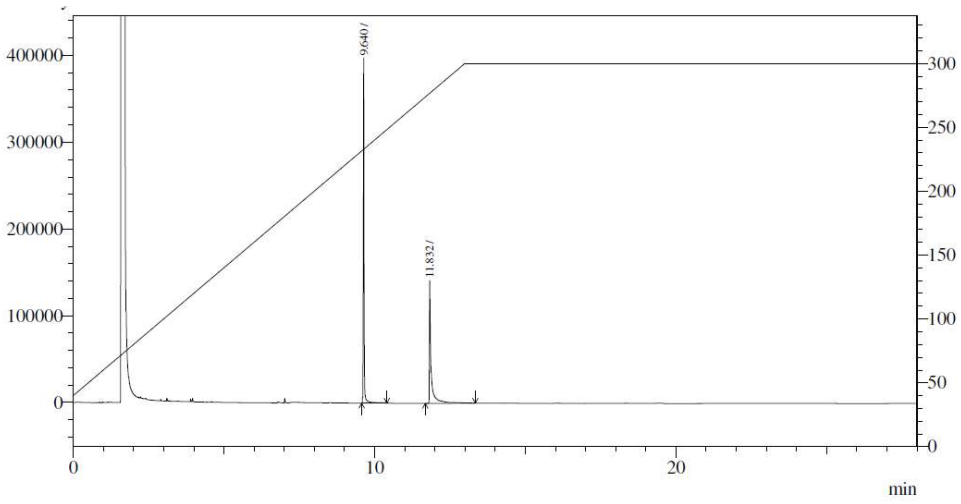

Figure S3. Chromatogram of the crude reaction product, with the small peak at 11.83 related to the 12-tricosanone and the sharp, high peak at 9.60 representing the internal standard eicosane.