

## **A. Supporting Information**

### **Content**

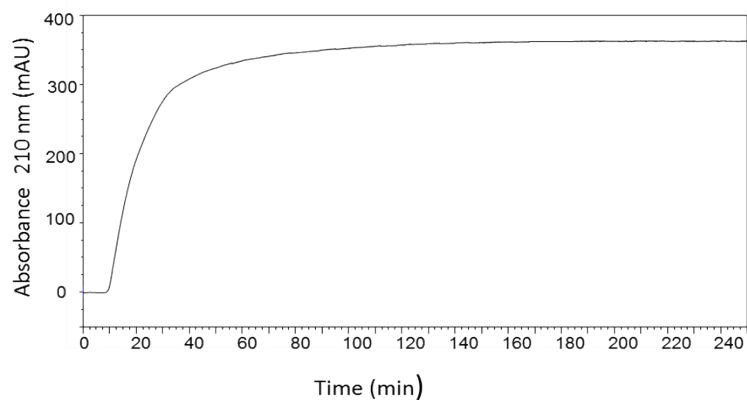
A.1 Loading of the resin with acetate, succinate and lactate

A.2 X-Ray photoelectron spectroscopy (XPS) of the anion exchange resin

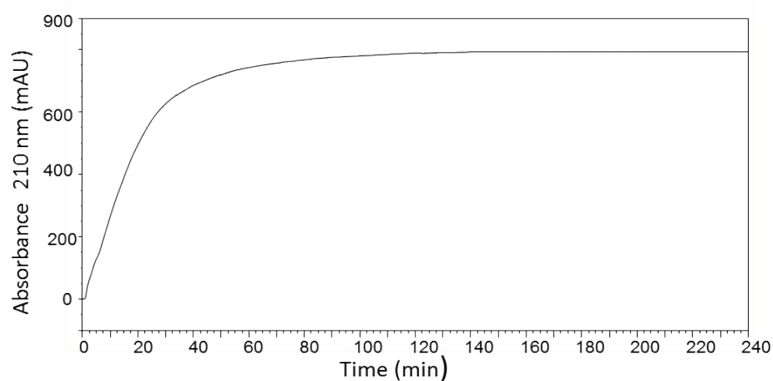
A.3 Thermogravimetric analysis (TGA) of the resin for detection of water content

A.4 Desorption of acetate with water and carbon dioxide

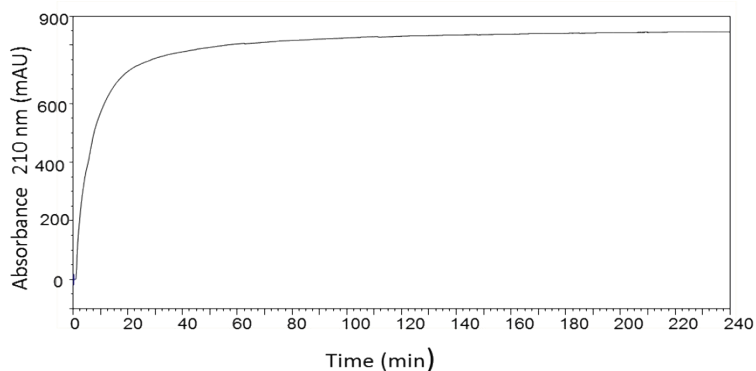
### A.1 Loading of the resin with acetate, succinate and lactate



**Figure A.1.** Loading of Dowex MSA (~5 g wet resin) with 2 mL/min of a solution of potassium acetate (10 g/L)



**Figure A.2.** Loading of Dowex MSA (~5 g wet resin) with 2 mL/min of a solution of sodium succinate (20 g/L)



**Figure A.3.** Loading of Dowex MSA (~5 g wet resin) with 2 mL/min of a solution of sodium lactate (20 g/L)

## A.2 X-Ray photoelectron spectroscopy (XPS) of the anion exchange resin

### A.2.1 Surface composition of Dowex Marathon resin with different counter-ions

**Table A.1** X-ray photoelectron spectroscopy analysis of Dowex Marathon resin\*

Resin Counter-ion	Condition of the resin	Surface atomic composition (%)			
		C	O	N	Cl
Chloride	wet	75.57 ± 0.08	14.94 ± 1.99	5.06 ± 0.86	3.36 ± 1.42
Chloride	dry	82.62 ± 0.26	5.40 ± 0.21	6.25 ± 0.26	5.57 ± 0.02
Acetate	dry	77.31 ± 0.76	18.45 ± 1.42	2.66 ± 2.14	Not present
Bicarbonate	dry	79.33 ± 0.78	12.88 ± 1.59	4.8 ± 0.52	Not present
Recycle (MeOH+ CO <sub>2</sub> )	dry	79.33 ± 0.78	14.39 ± 0.17	6.06 ± 0.31	0.42

\*Relative constitution as C, O, N and Cl

**Table A.2** X-ray photoelectron spectroscopy of preliminary Dowex Marathon resin loaded in batch mode (not a complete anion exchange)

Resin Counter-ion	Condition of the resin	Surface atomic composition (%)			
		C	O	N	Cl
Chloride	dry	81.7 ± 2.4	6.0 ± 1.4	6.2 ± 0.7	6.1 ± 1.3
Acetate	dry	83.7 ± 0.1	7.2 ± 0.3	5.7 ± 0.2	3.5 ± 0.1
Bicarbonate	dry	78.7 ± 0.5	15.6 ± 1.5	3.2 ± 0.8	2.4 ± 0.5

\*Relative constitution as C, O, N, Cl

Table A.2 shows that on a batch process the resin is not fully exchanged, and some remaining chloride anion are bounded to the resin.

### A.2.2 Deconvolution of C peak

The aim with de analysis of the deconvolution of the carbon peak is to analyse the type of the C bonds present at the resin surface. The deconvolution of the C peaks was done by keeping the C-C bond as internal standard at 284.8 eV.

**Table A.3** Percentage of C-C, C-O and C=O bonds from the high resolution spectra\*

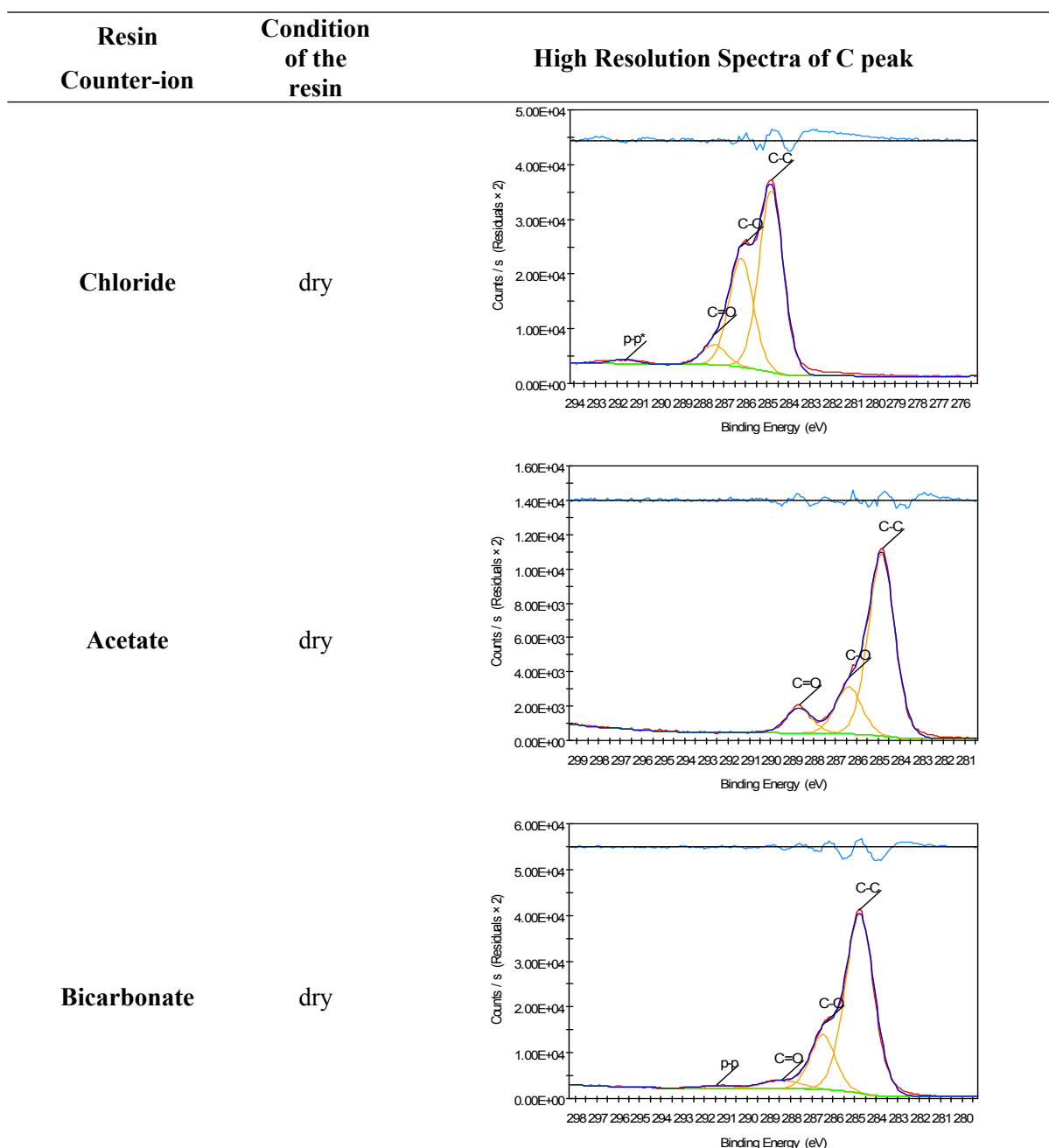
Resin Counter-ion	Condition of the resin	%C-C	%C-O	%C=O	%π - π <sup>†</sup>
Chloride	dry	57.6	34.6	6.3	1.5
Acetate	dry	71.5	18.5	9.9	Not observed
Bicarbonate	dry	74.1	20.0	4.6	1.4
Recycle (MeOH+ CO <sub>2</sub> )	dry	60.1	30.82	7.2	1.9

\*The fitting was done on representative spot for each sample.

†The π-π bond is calculated and represents the presence of the aromatic ring in the resin structure.

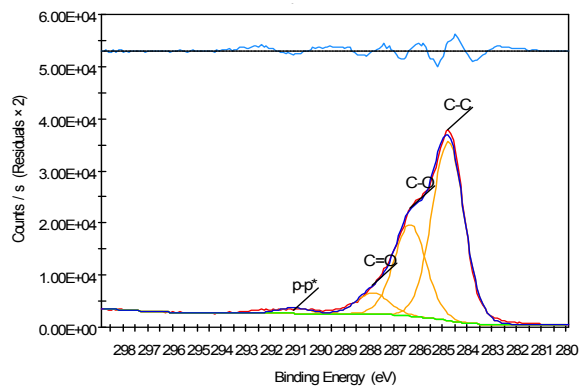
The deconvolution of the C peak shows three type of bonds for all the samples: C-C, C-O and C=O. Except for the acetate sample, all the other samples have the  $\pi - \pi^*$  transition, typical of the presence of aromatic rings. The wet chloride resin presents a lower amount of C-C (40.97) in comparison with the dry resin (57.63), but a higher amount of C=O (18.18) in comparison with the other samples. This might be because the water strongly binds to the resin, and for this reason the adsorbed water was further quantify with TGA. The C-C values increase for the acetate and bicarbonate resin in comparison with the chloride form of the resin. Moreover, the acetate form has a higher value of C=O (9.92) compared to the bicarbonate form (4.57).

### A.2.3 X-ray photoelectron spectroscopy spectra

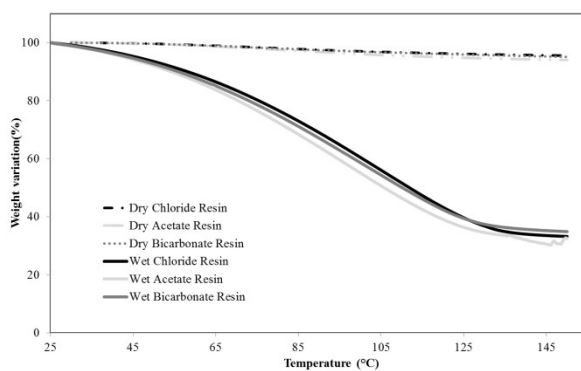


Recycle (MeOH+  
CO<sub>2</sub>)

dry



### A.3 Thermogravimetric analysis (TGA) of the resin for detection of water content



**Figure A.4.** Thermogravimetric analysis of the resin in chloride, acetate and bicarbonate form

### A.4 Desorption of acetate with water and carbon dioxide

**Table A.5** Desorption of acetate from an anion exchange resin with CO<sub>2</sub> at 10 bar in water at 20-22 °C with a resin loading of 3.4 %w/w dry resin/water

Equilibrium CO <sub>2</sub> pressure (bar)	Desorbed acetic acid (mg/g)	Desorption (mol acetic acid/mol acetate <sub>in</sub> )
10.1±0.1	1.23±0.48	0.38±0.05