Appendix B - Design of 122 L prototype MFC

The purpose of this appendix is to provide additional detail regarding the 122 L reactor set-up and design and it should be regarded in parallel with the designs and descriptions of Chapter 3. As presented in that section, the main 122 L prototype reactor set-up remained unchanged throughout this study. There were only two modifications in the reactor that did not alter the overall set-up. After the first maintenance operation, the reactor was internally divided in two sub-reactors by sealing the internal flow at the point represented by the red circle in the Figure below. The second modification was the replacement of the four anodes in $MFC_{R1\text{-}R4}$ with the carbon fibre design during the latter experimental part.

Additionally to the above description, Figure B-1 below depicts the 122 L reactor set-up. (1) is the reactor consisting of eight anodes and eight cathodes. (2) is the anode and the green arrows represent two out of the eight points where the anodes were placed within the reactor. (3) is the cathode block consisting of two identical cathode units facing each other on a mirrored position and the blue arrow represents one out of the four points where the cathode blocks were placed within the reactor. Therefore, starting from the front rear where the influent enters the reactor (4) and moving towards the back rear of the reactor, the electrodes are placed as following: (Anode – Cathode – Cathode – Anode) – (Anode – Cathode – Cathode – Anode) – (Anode – Cathode – Cathode – Anode) – (Anode – Cathode – Cathode – Anode).

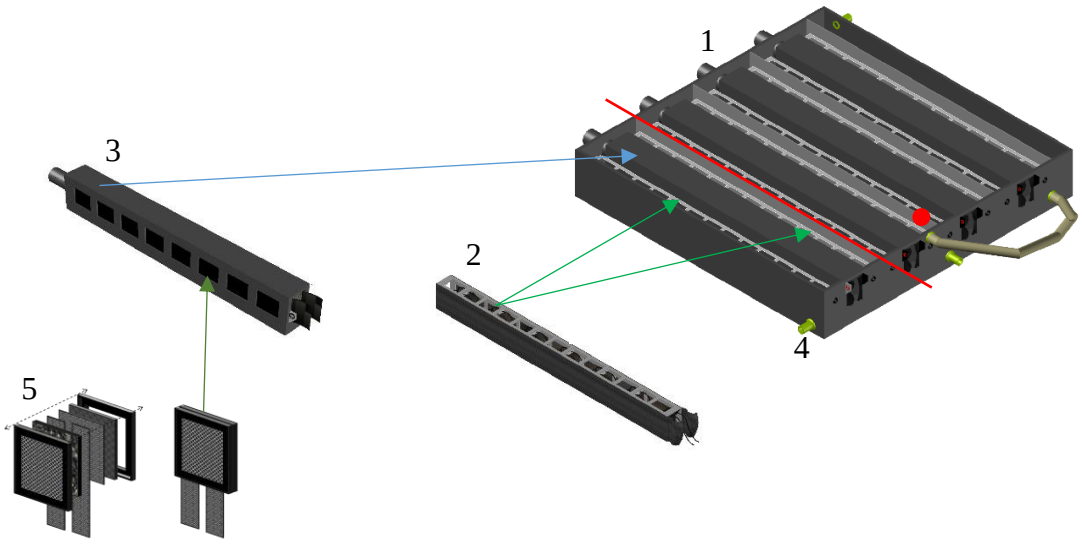

Figure B-1: *122 L reactor set-up*

As previously described in Chapter 3, (5) depicts the composition of a cathodic window. Each cathode unit consisted of eight of these windows, thus each cathode block consisted of 16 of these windows, and the orange arrow represents the point on the cathodic electrode where each window was placed.

Figure B-2 below is a schematic of a front section of the 122 L reactor. The various colours were used in order to more easily describe the different materials. The black mass represents the PVC material used as the reactor skeleton. The orange tube in the left side is the influent point where the wastewater was continuously pumped in the reactor. The black PVC skeleton kept the anodic construction in place and the anode was placed on the base of the reactor. The dark purple layer represents the carbon cloth, on which activated carbon granules (black granules) were fixed with conductive glue (green layer). The same mirror construction was placed on the opposite side of the anodic skeleton with a 6 cm distance between them. This constituted the anodic electrode which corresponds to (2) on Figure B-1.

Welded on a 1 cm distance was the cathode block which consisted of two identical cathode units facing each other on a mirrored position. The grey layer represents the graphite plate which was fixed on the PVC frame with epoxy resin. The side facing the anodic compartment was coated with the PFSA membrane (no colour due to the material being coated). Then a layer of carbon cloth (dark purple layer) was laid which extended horizontally throughout the cathode unit physically connecting the cathode windows. Two strips of carbon cloth (bright purple layer) were laid over the previous carbon cloth layer which extended through the PVC skeleton, exiting the reactor on the bottom in order to tap into the electrolyte bath placed below the MFC reactor (if existing). A layer of activated carbon granules (black granules) impregnated with the iron (II) phtalocyanin catalyst was placed and the entire window structure was held in place pressed against a net aperture (red layer). This consisted one window which corresponds to (5) in Figure B-1 and the overall cathode unit consisted by eight of these windows. The cathode block was completed with an identical cathode unit facing the previous cathode unit on a mirrored position. Facing the block on the right side was an anodic electrode positioned in the same manner as the previous one. This constituted the basic reactor set-up of an Anode-Cathode-Cathode-Anode. Finally, the dashed grey layer represents the lid that was placed on top of the reactor as a seal.

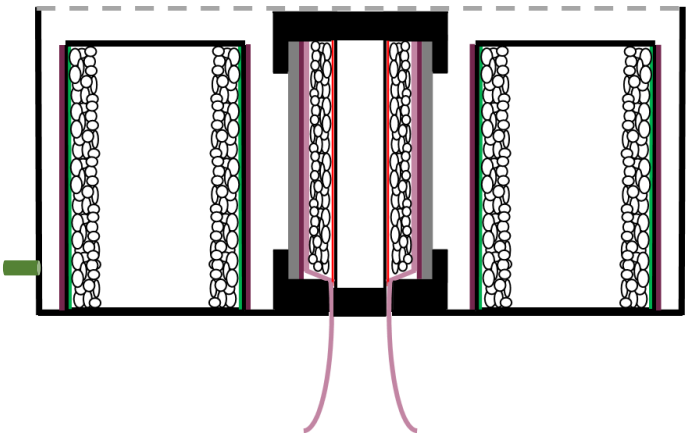

***Figure B-2**: Schematic of basic section of 122 L reactor (Anode-Cathode-Cathode-Anode)*

The 14 L reactor consisted of only one of the basic set-ups and this can therefore be considered a complete front section of the 14 L reactor. The 122 L prototype used throughout this study consisted of four of these sections as presented in Figure B-2. Finally, Figure B-3 below depicts two of these main constructions which after the first maintenance operation constituted a sub-reactor. The purpose of this figure is to depict the internal flow. Wastewater entered the reactor on the front rear of the first anodic compartment seen on the left side below, circulated to the back, entered the back of the second anodic compartment, circulated to the front, where it entered the front of the third anodic compartment from the internal passage (depicted as the grey dashed line) and followed the same circulation until exiting the reactor.

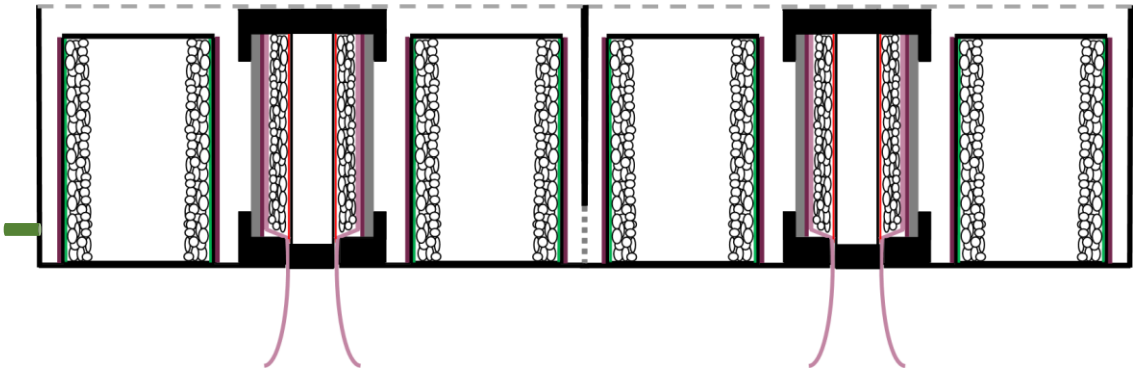

***Figure B-3**: Schematic of sub-reactor depicting point of internal flow*