**Appendix A**

**Process Group: CNF film life cycle inventory**

**Process Name: Spray Deposited CNF films**

**Reference Flow: 1 ton of CNF film**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Category** | **From** | **Process Name in Database** | **Database** | **Quantity** | **Unit** | **Assumption** | **Notes** | **Reference** |
| **Material** | Titanium | - | - | - | 856.693 | kg | 3:1:2 molar ratio for 1 Ti3AlC2 |  | [1] |
| Aluminum Powder | - | - | - | 160.966 | kg | 3:1:2 molar ratio for 1 Ti3AlC2 |  | [2, 3] |
| Graphite (Carbon) | - | - | - | 143.307 | kg | 3:1:2 molar ratio for 1 Ti3AlC2 |  | - |
| 48% HF Etching | - | - | - | 3482.898 | L | 1g of Ti3AlC2 is etched with 3ml of 48%HF |  | [3] |
| 37% HCl | - | - | - | 20897.388 | L | 1g of Ti3AlC2 is etched with 37% HCl |  | - |
| DI Water Etching |  |  |  | 10448.6 | L | 1g Ti3AlC2 is etched with 9ml DI water |  |  |
| LiCl Delamination |  |  |  | 1160.966 | kg | 1g Ti3AlC2 is delaminated with 1g of LiCl |  |  |
| DI Water Delamination |  |  |  | 58048.3 | L | 1g Ti3AlC2 is delaminated with 50ml of DI water |  |  |
| Argon gas |  |  |  | 2500 | m3 | Inert Environment |  |  |
| Water Washing |  |  |  | 491..4 | m3 | 481L per kg Mxene water required for washing |  |  |
| **Transportation** | Raw Material |  |  |  | 23930.6 | MJ | Transporting in a diesel truck from industrial area to the production site assumed distance: 200km |  | [3, 4] |
| **Electricity** | Type | AU | Electricity mix (Production mix) |  |  |  |  | The source of electricity generation are mainly fossil fuels in Australia accounting approximately 80% of the total, while wind is considered as the largest source of renewable energy for electricity production | [5] |
| MAX synthesis- Tube Furnace | AU |  |  | 108,250 | KWh | . |  | [6] |
| MAX synthesis- Stirrer/hot plate | AU |  |  | 53,200 | KWh |  |  |  |
| MAX synthesis-centrifuge | AU |  |  | 22,800 | KWh |  |  |  |
| MAX synthesis- Ball Mill | AU |  |  | 3800 | KWh |  | Power rating of spray pump is 0.6 kW |  |
| Belt Conveyor | AU |  | E | 600 | MJ |  | Power rating of belt conveyor is 0.75 kW |  |
| MAX synthesis-vaccum pump | AU |  |  | 1900 | KWh |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Drying | AU |  | Ecoinvent | 14000 | MJ | Drying is conducted in an area made via |  | [7] |
| **Product** | Mxene | - | - | 1 | ton | - | - |  |  |
| **Impact of Feedstock** | | | | | | | | | |
| **Material** | Tire derived Carbon |  |  | 143.307 | kg |  |  |  |  |
|  | LiF |  |  | 1000 | Kg |  | Alternative etching route LiF + HCl  HF + LiCl |  | [8] |

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