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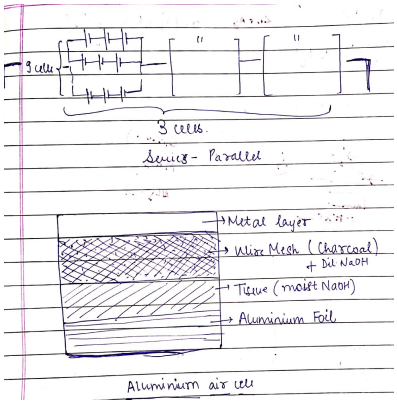
Abstract:

- **Type of battery - Aluminium Air**





- **Procedure:**
  1. We have constructed an Aluminium Air battery with an optimal combination of series and parallel cells.
  2. We have made handmade wooden compartments with ply and nails and sealing the compartments with m-seal.
  3. Firstly, we have placed a layer of aluminium foil, covered it with NaOH soaked tissue and then added a layer of charcoal over a wire mesh to increase the surface area of contact of charcoal with metal.
  4. Charcoal provides reduction surface for oxygen in battery as Cathode.
  5. Aluminium acts as the anode over which oxidation takes place.
  6. We have stacked layers of this cell in the small compartment in series.
  7. In each compartment we have 3 cells in series, all these 9 compartments on one level are in parallel and the 3 levels are again in series forming optimized combination of 3*9*3 = 81 cells.

- **Chemicals and Chemical Reactions:**

  The anode oxidation half-reaction is $Al + 3OH^- \rightarrow Al(OH)3 + 3e^-$ +2.31 V.

  The cathode reduction half-reaction is $O2 + 2H2O + 4e^- \rightarrow 4OH^-$ +0.40 V.

  The total reaction is $4Al + 3O2 + 6H2O \rightarrow 4Al(OH)3$ + 2.71 V.

- **Results:**

  1 cell - Resistance R , Current I , Voltage V
  Each compartment has 3 cells - Series ; 3*V
  Each level has 9 cells - Parallel ; 9*I
  3 levels - Series ; 3*3*V
  So, finally we get 9 times current and 9 times voltage that of an individual cell and this is the best possible out of all the combinations we tried.
  Experimental (one cell) - 1.7V , 8mA

- **Budget:**

ITEM	COST
M-seal	210
Wire mesh	40
Crocodile clips and feviquick	60
Jugaad	Got us all other things for free, from trash, BEST OUT OF WASTE!

- **Observation:**
  1. Electrolyte: We used salt solution(KCl) at first that gave low voltage output of about 1.1V. Then we switched to basic electrolyte dilute NaOH (0.1M) which gave a voltage output of 1.7V for each cell
  2. Electrodes : We used plate electrodes with spiral of aluminium below to increase the surface area as much as possible and wire mesh to increase surface of charcoal
  3. Resistance: We have grinded charcoal into very fine powder to increase surface area of contact and reduce resistance in cell
  4. Current collector: We initially placed our negative end directly onto charcoal but it didn't collect any current so we switched to placing aluminium cover over charcoal , so that the metal collects current. Finally, we used metal in combination with wire mesh to increase cell efficiency and ensure maximum current collection.
  5. Insulation: To ensure that the cells don't get shorted in series - parallel combination due to exchange of electrolytes , we have sealed the compartments with m-seal which is non-conducting and water-proof
  6. Catalyst: We have used MnO_2 as catalyst to increase reactivity of cell
  7. Space optimization: We have tried to cover each centimeter of the 10cm*10cm*10cm volume by integrating 81 cells within it
  8. Air gaps: We tried compact cell without air gap but the voltage output was very less and we realized that charcoal needed more oxygen for better result. We have made the height of bars of each cell uneven so that the 3 levels have air spaces in between for more oxygen flow ,to produce to more current and voltage
  9. Other battery options: We also tried Copper & Aluminium battery but the voltage out of it was only 1.2V and current was about 3mA, so we finally switched to aluminium cells that gave maximum output in the electrolytes and electrode range available.
- **Conclusion:** We are using a battery that is a combination of carbon that is readily available and aluminium which is one of the most abundant metals. We mainly focus on optimizing the already available cell technologies with basic knowledge of electricity and circuits. It increases the current and voltage several times of that of an individual cell if made close to ideal conditions with proper catalyst . This battery can be used in combinations to power many devices in general as it has a sufficiently high rating and is practical enough.