**Design Criteria and Constraints**

**Introduction**

There are 6 different types of hydroponic systems. Without the use of energy and the need to easily sustain and maintain the system we have decided to use either a wick system or a deep water culture system (DWC). These types of systems are relatively cheaper, are able to reuse nutrients and water, and does not require electricity to operate.

Using the needs identification for our client we have devised guidelines that our design must meet (see “List 1”). These guidelines will be used to benchmark pre-existing competitive products.

**List 1:**

Functional requirements

* Filtration system
* Water reservoir capacity
* Simple design (easy to set up/maintain)
* Leak proof
* Pest proof
* Nutrient and water recyclability
* Man powered or devoid of use of energy
* Stability

Constraints

* Cost ($)
* Dimensions (LxWxH (m))
* Weight (lbs/kg)
* Capacity (L)
* Temperature (oC)
* Operating conditions: Temperature

Non-functional requirements

* Product life (years)
* Aesthetics

Reliability

**Table 1: Benchmark**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Importance | Wick System | AutoPot -  easy2grow Kit | Deep Water System | Viagrow® Recirculating Deep Water 4 Bucket System |
| Company |  | Powerhouse Hydroponic | Autopot USA | Sales5 | Viagrow |
| Cost ($) | 5 | 107.30 | 79.95 | 101.37 | 139.99 |
| Dimensions (LxWxH)  (in) | 4 | Grow tray (20x2x5)  Tank  (12x8x6) | Grow tray (9.6x7.8x7.6) x 2  Tank (14.5x11x24) | 38x28x20 | 42x36x14 |
| Weight (lbs) | 3 | 6.4 | 7.6 | 6.0 | 25.0 |
| Nutrient and water recyclability | 5 | Yes | Yes | Yes | Yes |
| Filtration System | 2 | No | Yes | No | No |
| Capacity  (L) | 3 | 9.46 | 8.33 x2 | 50.00 | 18.93 x4 |
| Type | Wick/DWC | Wick | Wick | DWC | DWC |
| Material | 3 | Glass and Steel | Plastic | Plastic | Plastic |

**Table 2: Metrics**

(4 = Green, 3 = Yellow, 2 = Orange, 1 = Red)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Company | Importance  (weight) | Powerhouse Hydroponic | Autopot USA | Sales 5 | Viagrow |
| Cost ($) | 5 | 107.30 | 79.95 | 101.37 | 139.99 |
| Dimensions  (LxWxH)  (in) | 4 | Grow tray (20x2x5)  (0.12 ft³)  Tank  (12x8x6)  (0.33 ft³) | Grow tray (9.6x7.8x7.6) x2  (0.66 ft³)  Tank  (14.5x11x24)  (2.22 ft³) | 38x28x20  (12.31 ft³) | 42x36x14  (12.24 ft³) |
| Weight (lbs) | 3 | 6.4 | 7.6 | 6.0 | 25.0 |
| Recyclability | 5 | Yes | Yes | Yes | Yes |
| Filtration | 2 | No | Yes | No | No |
| Capacity (L) | 3 | 9.46 | 16.66 | 50.00 | 75.72 |
| Material | 3 | glass/steel | plastic | plastic | plastic |
| Total |  | 62 | 74 |  | 66 |

**EDS: Functional Requirements:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Design Specifications | Relation  (=, < or >) | Value | Units | Verification Method |
| 1 | Filtration system | = | Yes | N/A | Test |
| 2 | Water reservoir capacity | = | 20 to 80 | Litre | Analysis |
| 3 | Simple design (easy to set up/maintain) | = | Yes | N/A | Analysis |
| 4 | Leak proof | = | Yes | N/A | Test |
| 5 | Pest proof | = | Yes | N/A | Test |
| 6 | Nutrient and water recyclability | = | Yes | N/A | Test |
| 7 | Man powered or devoid of use of energy | = | Yes | N/A | Test |
| 8 | Stability | = | Yes | N/A | Test |

**EDS: Constraints:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Design Specifications | Relation  (=, < or >) | Value | Units | Verification Method |
| 1 | Cost | < | 100 | $ | Estimate, Analysis |
| 2 | Dimensions | < | 13 | ft³ | Analysis |
| 3 | Weight | < | 20 | lbs | Analysis |
| 4 | Capacity | = | 20 to 80 | Litres | Analysis |
| 5 | Operating conditions:  Temperature | = | -5 to 45 | O C | Test |

**EDS: Non - Functional Requirements:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Design Specifications | Relation  (=, < or >) | Value | Units | Verification Method |
| 1 | Product Life | > | 7 | Years | Test |
| 2 | Aesthetics | = | Yes | N/A | Test |
| 3 | Reliability | = | Yes | N/A | Test |

**Analysis:**

Considering our functional requirements, every company has products that were able to recycle and reuse water/nutrients. However, Autopot USA was the only company able to satisfy the requirement of a filtration system.

Considering our constraints, each product sacrificed some aspects to provide different benefits. Autopot had a low cost while sacrificing its size and capacity. Powerhouse Hydroponics while having a higher cost and a smaller size and capacity has the most durable material. Sales 5 and Viagrow both have a higher cost to compensate for its larger size.

**Conclusion:**

When considering our design criteria the top ranking benchmarked product is the Sales5 hydroponic system. However, Autopot USA’s hydroponic system was the only system with a filtration system and its results (refer to table 2) were close to Sales5. To compete with the benchmark companies our product should have a low cost, larger dimensions, a filtration system, while satisfying all of our other requirements and constraints.