The influence size and composition of bioreactor from sand and compost to improve hold up liquid of bed

A Fauzan* and R Rispiandi
Chemical Engineering Department, Bandung State Polytechnic, Bandung Barat, Indonesia

*ahmad.fauzan@polban.ac.id

Abstract. Increasing population in Bandung will cause the need for products from plants also increase, while the available land decreases so that it is necessary to intensify the process in agriculture. One of them is by making plant bioreactors that can facilitate availability of water and nutrients in the land. The purpose of this study is to obtain the influence of bed variations on hold up liquid parameters of a bed. The tests included hold up liquid tests of various bed variations consisting of variations in size (not sieved; 4 - 2 mm; 2 - 1 mm; 1 mm - 500 μm; 500 - 250 μm and 250 - 125 μm) and composition variations (100 : 0; 25:75; 50:50; 75:25 and 0:100) from compost and sand in order to get a good ratio of bed between sand and compost on hold up liquid in the soil. The total sample obtained is 30 samples. Based on the experimental results, it was concluded that the sand and compost with a ratio of 25:75 and diameter of 500 - 250 μm as a good composition to increasing the holdup liquid value of bed with 0.3 hold up liquid.

1. Introduction
The Central Statistics Agency get data on the population of Bandung in 2014 is 2,748,733 people with an area of 16,729.50 Ha an increase of 1.75% [1]. The increasing number of population makes the needs will also increase, as well as food. Food generally comes from plants. Plants must be able to sustain all living things [2,3]. With the increasingly limited land because it is used for residential settlements, then there must be other steps in increasing crop productivity, namely by, for example, making plant bioreactors.

2. Materials and methods

2.1. Materials
The compost that will be used in this study comes from the Bandung Institute of Technology and the sand that is used comes from the Geger Kalong Hilir Bandung river sand. The water used in the porosity testing process is ground water.

2.2. Methods
Research on the spatial structure of the plant bioreactor uses a methodology consisting of several stages, including: 1. Literature study; 2. Trial; 3. Data interpretation; and 4. Analysis of results; supporting data which will later be used as supporting information needed to develop research on the study of spatial structure and hydrodynamics of plant bioreactors. Experiments were carried out to obtain certain data,
namely data on bed characteristics and parameters in plant bioreactors. This was done by paying attention to previous research, namely by referring to previous research conducted by Fadian and Antony [4]. Meanwhile, some modifications will be made so that new experimental devices can be obtained. The data that is already available will be used in determining the parameters needed. However, it does not rule out the possibility that other data are still needed in various conditions that require to conduct experiments similar to those of other researchers. The relationship of these parameters can show the mechanism of flow and spatial structure so that empirical parameters will be obtained which have a price that can only be obtained from matching the experimental results. The bed variation used is used for the bed on hold up liquid test.

The experiment begins with sample preparation the determination of variations in the size of the sand and compost as well as variations in the composition of the sand and compost. Total sample obtained is 30 samples. The variations of experiments performed are shown in Table 1.

| Variations of experiments | Sand and compost particle size | composition sand: compost in bed ( % V – V) |
|---------------------------|-------------------------------|------------------------------------------|
|                           | Not sifted, diameter 4 – 2 mm, | 100:0 ; 25:75 ; 50:50 ; 75:25 dan 0:100 |
|                           | 2 – 1mm, 1 mm – 500 µm,       |                                          |
|                           | 500 - 250 µm and 250 µm – 125 µm |                                          |

The experiment begins with preparing a bed consisting of sand and compost. The sand and compost are first dried at 90 - 110°C in the oven for two hours. This is done to ensure that all water from the bed evaporates. After drying, each sand and compost is milled with a ball mill then filtered with sizing to get the desired size. The size collected from the mesh filter is considered as a measure of the average diameter applied to pipes in the compost and grains of sand. This is done because the particle diameter is one of the fixed parameters used in making the model being built. After the desired sample is obtained then on hold up liquid test is carried out without pressure (normal) of various beds.

3. Results and discussion

The hydrodynamic parameters obtained are the bed hold up liquid. The results of the test can be seen in the following table.
Table 2. Hold up liquid experiment result.

| Size Particle | Composition (%) | Volume (ml) | Hold Up | % Hold Up |
|---------------|-----------------|-------------|---------|-----------|
|               | Sand | Compost | Rainfall | Early |       |       |
| 4 mm - 2 mm   | 100  | 0       | 173      | 200   | 27     | 13.5  |
|               | 75   | 25      | 174      | 200   | 27     | 13.5  |
|               | 50   | 50      | 174      | 200   | 26     | 13    |
|               | 25   | 75      | 174      | 200   | 26     | 13    |
|               | 0    | 100     | 174      | 200   | 26     | 13    |
| 2 mm - 1 mm   | 100  | 0       | 160      | 200   | 40     | 20    |
|               | 75   | 25      | 168      | 200   | 32     | 16    |
|               | 50   | 50      | 158      | 200   | 42     | 21    |
|               | 25   | 75      | 168      | 200   | 32     | 16    |
|               | 0    | 100     | 168      | 200   | 32     | 16    |
| 1 mm - 500µm  | 100  | 0       | 154      | 200   | 46     | 23    |
|               | 75   | 25      | 158      | 200   | 42     | 21    |
|               | 50   | 50      | 159      | 200   | 41     | 20.5  |
|               | 25   | 75      | 158      | 200   | 42     | 21    |
|               | 0    | 100     | 158      | 200   | 42     | 21    |
| 500 µm - 250 µm| 100  | 0       | 144      | 200   | 56     | 28    |
|               | 75   | 25      | 150      | 200   | 50     | 25    |
|               | 50   | 50      | 144      | 200   | 56     | 28    |
|               | 25   | 75      | 125      | 200   | 75     | 37.5  |
|               | 0    | 100     | 138      | 200   | 62     | 31    |
| 250 µm - 125 µm| 100  | 0       | 148      | 200   | 52     | 26    |
|               | 75   | 25      | 135      | 200   | 65     | 32.5  |
|               | 50   | 50      | 132      | 200   | 68     | 34    |
|               | 25   | 75      | 136      | 200   | 64     | 32    |
|               | 0    | 100     | 136      | 200   | 64     | 32    |
| Not Sifted    | 100  | 0       | 155      | 200   | 45     | 22.5  |
|               | 75   | 25      | 132      | 200   | 68     | 34    |
|               | 50   | 50      | 154      | 200   | 46     | 23    |
|               | 25   | 75      | 153      | 200   | 47     | 23.5  |
|               | 0    | 100     | 154      | 200   | 46     | 23    |

From the results of this study it can be seen that the presence of compost in the soil used for farming is needed to ensure the of water and nutrients from the soil.

4. Conclusion

Based on the experimental results, it was concluded that the sand and compost with a ratio of 25: 75 and diameter of 500 - 250 µm as a good composition to increasing the holdup liquid value of bed with 0.375 hold up liquid. From the results of this study it can be concluded that the presence of compost in the soil used for cultivation is very necessary to ensure the water and nutrients from the soil. If the process of transporting nutrients from the environment to the roots is good so the process of transporting water is no longer a limiting rate for plants. Plants can produce satisfying results.

References

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