Equations show the mass and energy balance for the three tanks. The mass balance was performed around Tank 2 and 3.

Using the steady state values the variables were solved: k1=0.1118 kg s-1 m-1/2, k2=.02236 kg s-1 m-1/2, F=0.9567, T2 = 70°C. It is assumed that this percentage of concentration is constant at any steam flow rate. With these constants the inputs, outputs and disturbances were identified on Table 1:

Table 1. Variable identification

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Device** | **State** | **Input** | **Output** | **Disturbance** |
| **Tank 1** | , | , | = |  |
| **Tank 2** | , | = | = |  |
| **Tank 3** |  |  | == |  |

Substituting these values into the system the equations became:

These results were furthere linearlized into:

Figure 1 to Figure 6 shows the model after 5% step changes. These are small step changes; therefore, the observed change is small. When the hot water flow was increased, the level in the tank increased and the temperature decreased. The water flowing into tank 1 was greater the water coming out, so the water level increased in the tank. With constant steam condensation, the temperature increase due to inability to heat the extra hot water. The opposition is happens when hot water flow is decreased. Less water enters but the flow rate is changed, so the level decreases. Same amount of energy into less mass causes the interature to increase. A similar effect on level is seen in tank 2 was cold water flow changes, but to the hydrostatic equalibirum between tank 2 and 3. Water level in the tank increases and decrease proporationally with the cold water flow. Finally, steam flow rate only effects the temperature of the tanks. Temperature in tank 1 is proportional increase. More energy is provided to the water, so temperature increases. Likewise occurs with increased steam flow.



Figure . Hot Water Flow to .0525



Figure . Hot Water Flow to .0475



Figure . Cold Water to .0525



Figure . Cold Water to .0475



Figure . Steam to .0044



Figure . Steam to 0.0040