

# Simulation of a Blending Tank with Proportional Control

File: Ch02\_BlendingTank.m

A blending tank accepts a flow from a plant at mass flow rate  $w_1$ . The mass fraction of A is  $x_1$ . A stream of pure A ( $x_2 = 1$ ) is blended with the plant stream in a well-mixed tank. The tank is designed to maintain constant volume. The task is to design a control system to maintain the effluent concentration at a desired setpoint  $x_{SP}$ .

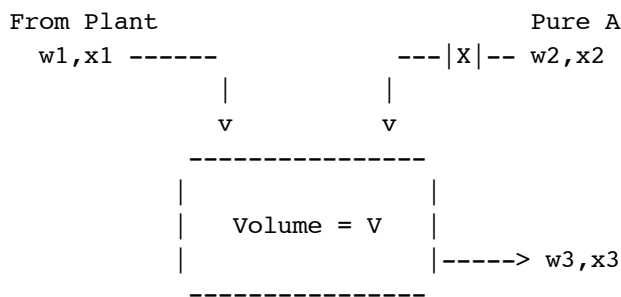
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## Process Diagram

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## Parameter Values

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```
rho = 1.00; % kg/liter, assume constant
V = 4000; % liters
```

## Disturbance Variables (DV)

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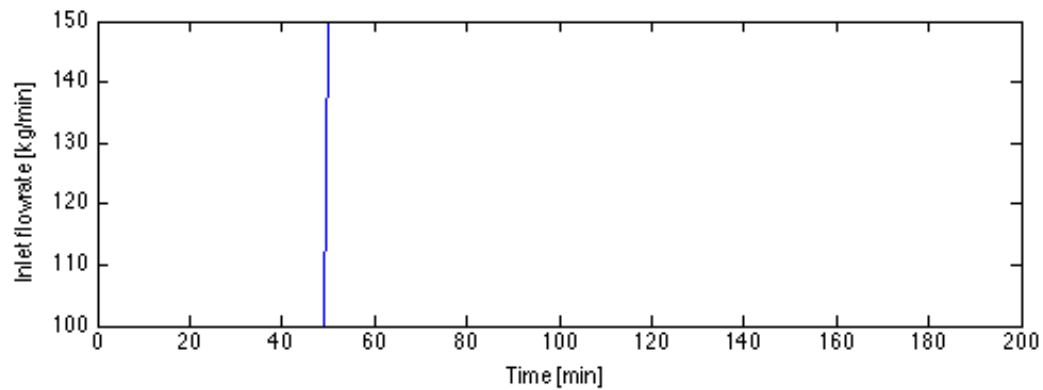
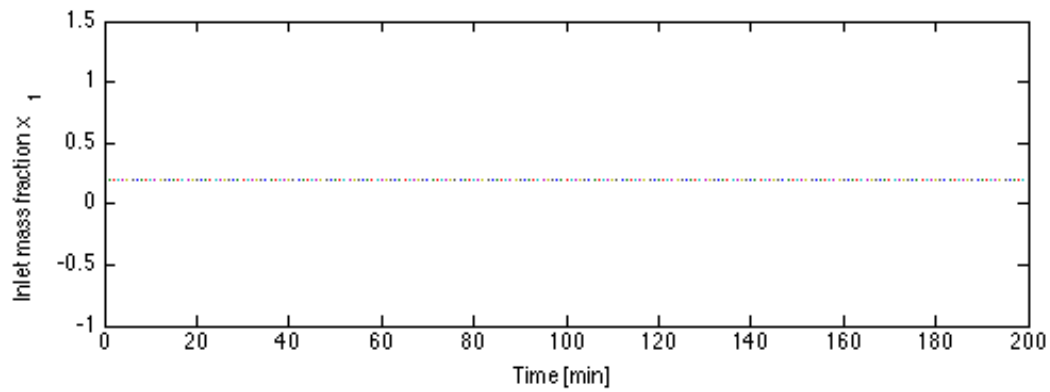
The disturbances are functions of time. Here we specify a constant value for  $x_1$ , and a flowrate  $w_1$  with a step change at  $t = 50$ .

```
x1 = @(t) 0.2; % Mass fraction
w1 = @(t) 100 + (t >= 50).*50; % kg/min

t = 0:200;
subplot(2,1,1);
plot(t,x1(t));
xlabel('Time [min]');
ylabel('Inlet mass fraction x_1');

subplot(2,1,2);
plot(t,w1(t));
xlabel('Time [min]');
```

```
ylabel('Inlet flowrate [kg/min]');
```



## Manipulated Variable (MV)

$w_2(t)$  is the flowrate of the manipulated flow. For the first simulation we'll assume a constant flowrate.

```
w2 = @(t) 50; % kg/hour
```

## Blending Tank Model

For a simple problem like this one, we'll use an anonymous function to model the tank dynamics.

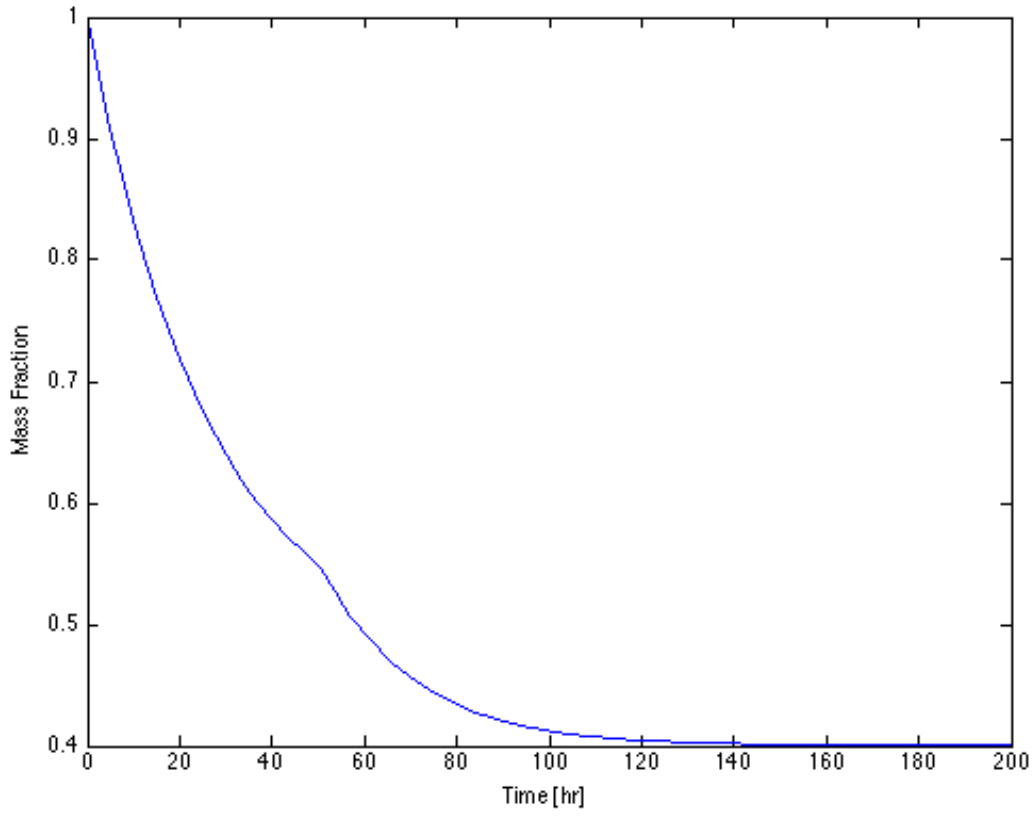
```
f = @(t,x) (w1(t)*(x1(t)-x) + w2(t)*(1-x))/rho/V;
```

## Integrate differential equation and plot results

We integrate the model from  $t = 0$  to  $t = 200$  with an initial condition  $x(0) = 1$ .

```
[t,x] = ode45(f,[0,200],1);  
clg;  
plot(t,x);  
  
xlabel('Time [hr]');  
ylabel('Mass Fraction');
```

Warning: This function is obsolete and may be removed in future versions. Use Clf instead



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