Application 1

A batch process is used to produce a chemical product in a certain factory. The batch is performed by collecting 2 different solid materials in a hopper. These materials are mixed with a powder and liquid in a mixer as shown in Fig.1. The sequence of batch is carried out according to the following steps:

1) Discharge the first solid material in the hopper by opening the feeding valve (FV1) until a load cell measures the desired weight.
2) Discharge the second solid material in the hopper by opening the second feeding valve (FV2) until the load cell measure the sum of the two solid materials weight.
3) The liquid and powder are weighted individually using another two load cells attached to their weighting units by controlling the feeding valves (FV3 and FV4)
4) All the materials are poured into the mixer by opening the discharging valves DV1, DV2 and DV3 until all load cells measure zero.
5) The mixer operates a sewer to mix the 4 materials for 20 min.
6) The product of mixer is discharged into the packing system by opening the discharge valve of mixer (DV4).

As shown in Fig. 1, load cells is used to measure the weights of the raw materials. The sensors have the following specifications:
Load cell of the hopper has an output 0 - 10v for a weight range 0 – 10 ton;
Load cell of the powder has a sensitivity 0.1v/kg for a range 0 – 100kg;
Load cell of the liquid has a sensitivity 0.01v/kg for a range 0 – 1000kg.

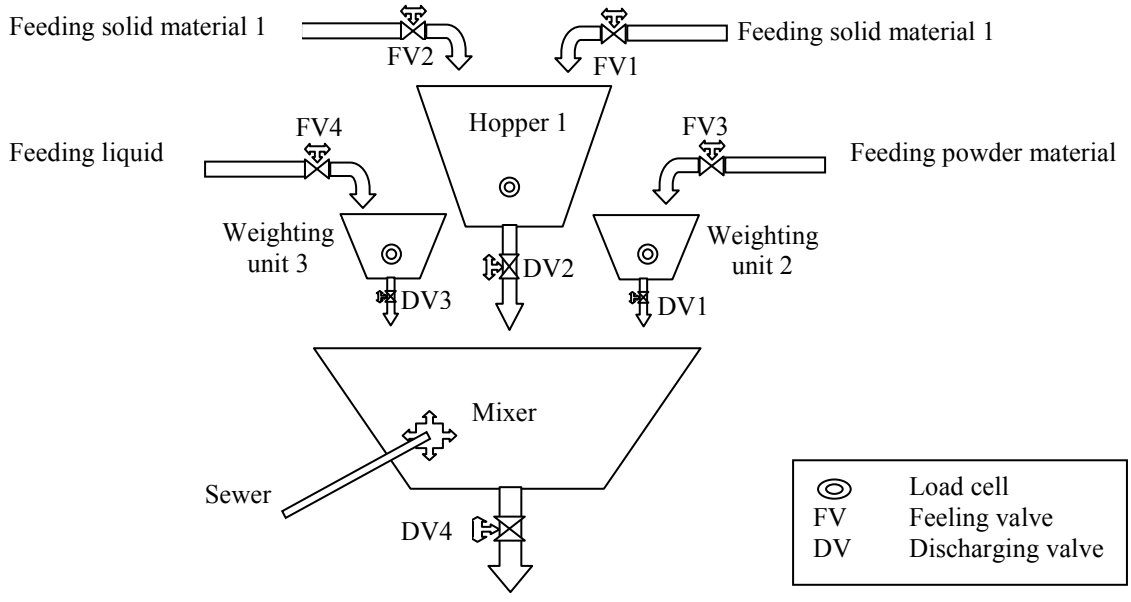

Fig. 1

a) Design an Automation system that perform the required task***; knowing that the weights of materials as 1 ton, 2 ton, 80kg, and 500kg respectively.***

b) If the discharging valve (DV4) is replaced by a regulating valve that is controlled by 4-20mA current signal, modify the automation system that maintains the discharging rate to be 10kg/s.

select the required auxiliaries such as push bottoms, indicators, switches, etc…

Application 2

Multi-pump system is suggested to compensate the high demand of water. A water user shall be supplied with water on demand via four pumps. The load is measured by using a pressure sensor that indicates the consumption of water to the utility. An equal load for all pumps should be ensured taking into consideration the operating times, by switching pumps on and off. The pumping output of a pump which has been released for maintenance shall be automatically taken over by a pump with free capacity. Fig. 2 shows the schematic diagram of pumping system

In addition to the automatic operation, it shall also be possible to operate each pump manually. In order to take into consideration the various pump types, it shall be possible to operate all pumps in positive and negative direction. Four asynchronous motors are used to operate each pump.

a) Design complete automation system that achieve the required task in the following two cases:

1- Each motor speed is adjusted using an Ac drive.

2- Only one AC drive is used to switch between different pumps and the other either direct online of off based on the load.

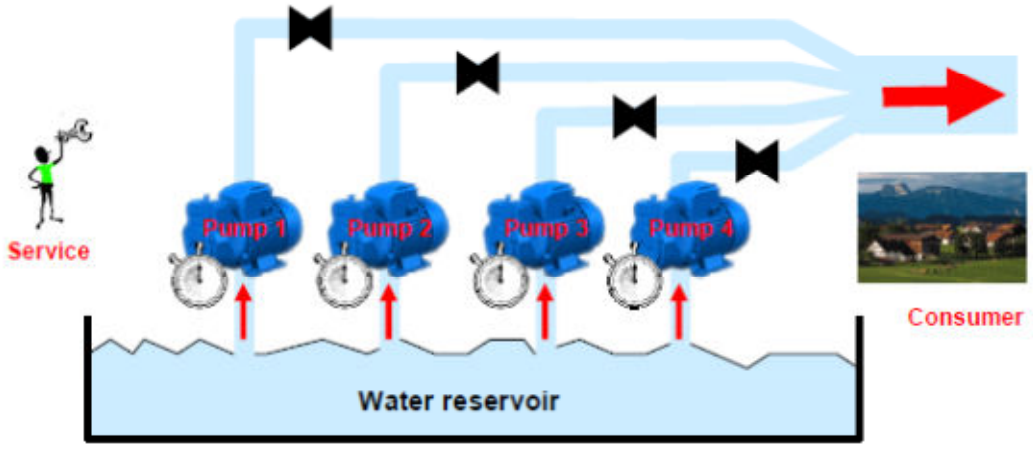

Fig.2