Simulation Effect & Calculation of Accumulator Discharge for Hydraulic Bollard System

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Abstract: Hydraulic systems are the preferred item is a gas charged accumulator, but simple systems may be spring-loaded. There may be more than one accumulator in a system. The exact type and placement of each may be a compromise due to its effects and the costs of manufacture. An accumulator can maintain the pressure in a system for periods when there are slight leaks without the pump being cycled on and off constantly. When temperature changes cause pressure excursions the accumulator helps absorb them. Its size helps absorb fluid that might otherwise be locked in a small fixed system with no room for expansion due to valve arrangement. Simulation is the imitation of reality. In this paper we will calculate the accumulator Discharge for Hydraulic Bollard System.

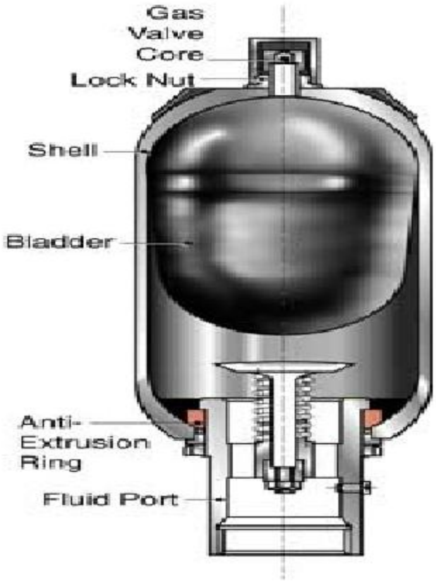
Keywords: Simulation, Accumulator, Bollard System

Introduction:-

Hydraulic systems the preferred item is a gas charged accumulator, but simple systems may be spring-loaded. There may be more than one accumulator in a system. The exact type and placement of each may be a compromise due to its effects and the costs of manufacture.

An additional benefit is the additional energy that can be stored while the pump is subject to low demand. The designer can use a smaller-capacity pump. The large excursions of system components, such as landing gear on a large aircraft, that require a considerable volume of fluid can also benefit from one or more accumulators. These are often placed close to the demand to help overcome restrictions and drag from long pipe work runs. The outflow of energy from a discharging accumulator is much greater, for a short time, than even large pumps could generate.

An accumulator can maintain the pressure in a system for periods when there are slight leaks without the pump being cycled on and off constantly. When temperature changes cause pressure excursions the accumulator helps absorb them. Its size helps absorb fluid that might otherwise be locked in a small fixed system with no room for expansion due to valve arrangement.



Size calculation of Accumulator:-

Hydraulic System consist of various components that power by Electrical supply. If the Supply fails the system shuts down or if failure of any components occurs such as pump, motor etc end function may not be achieved as desired.

Accumulator generally has partition in which one side is filled with Nitrogen/Inert gas (Oxygen should not be used) the other side of the partition is filled with hydraulic fluid.

For calculation of accumulator we require four parameters which are:-

1. Maximum Pressure = P2(Maximum System Operating Pressure)
2. Minimum Pressure = P1(Minimum system operating Pressure)
3. Pre-charge pressure = P0(Pressure at which the nitrogen gas to be filled inside the accumulator (Generally taken as 90% of the minimum operating pressure))
4. Differential Volume = ΔV-The Volume which accumulator needs to store so as to deliver during emergency situation.

Other parameters are: - V0 = Total Gas Volume.

V1 = Volume at Minimum pressure.

V2 = Volume at Maximum Pressure.

In our System the above parameters are as follows:-

- P2=110 bar.
- P1:- 70 bar.
- P0:- 63 bar.
- ΔV: - 3 liters.

Pre-selection & Result at working Temperature 15^{0}C:

Pressure data [bar]	Temperature data [°C]	Volume data [L]
Max. working pressure : 110	Min. temperature : 15	Differential Volume : 3
Min. working pressure : 73.08	Max. temperature : 45	Accumulator Gas Volume : 18.4
Pre-charge pressure : 63	Pre-charge temperature : 20	
Gas Pressure : 61.75		
Discharge-adiabatic (fast)		
Gas Type : N2		
Charge-isotherm		

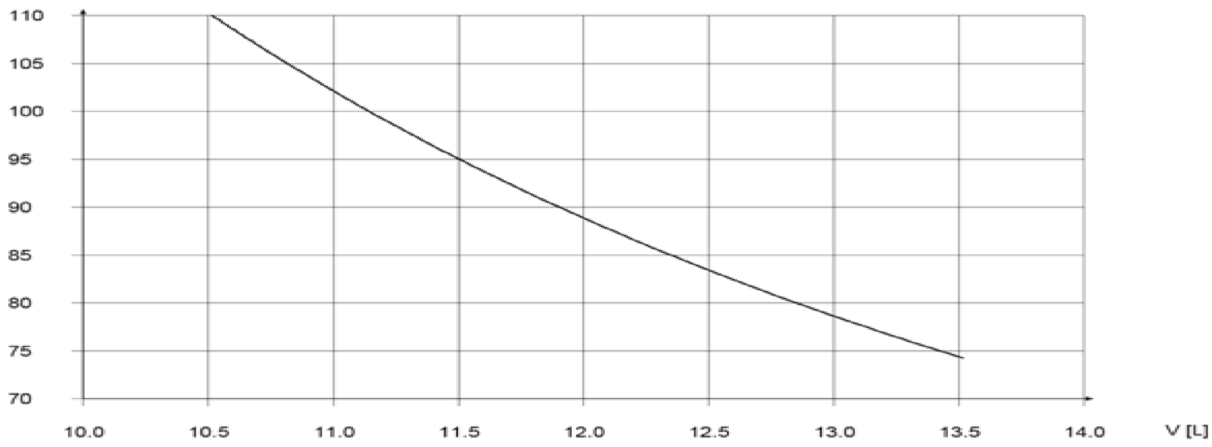
Table-1

cycle	t [s] (tot.)	t [s] (cyc.)	p [bar]	T [°C]	V [L]	DeltaV [L]	Q [L/min]
1	0.000	0.000	110.00	17	10.516	0.000	0.600
1	1.000	1.000	100.38	7	11.116	0.600	0.600
1	2.000	2.000	92.26	1	11.716	1.200	0.600
1	3.000	3.000	85.34	-5	12.316	1.800	0.600
1	4.000	4.000	79.39	-10	12.916	2.400	0.600
1	5.000	5.000	74.22	-14	13.516	3.000	0.600

Table-2

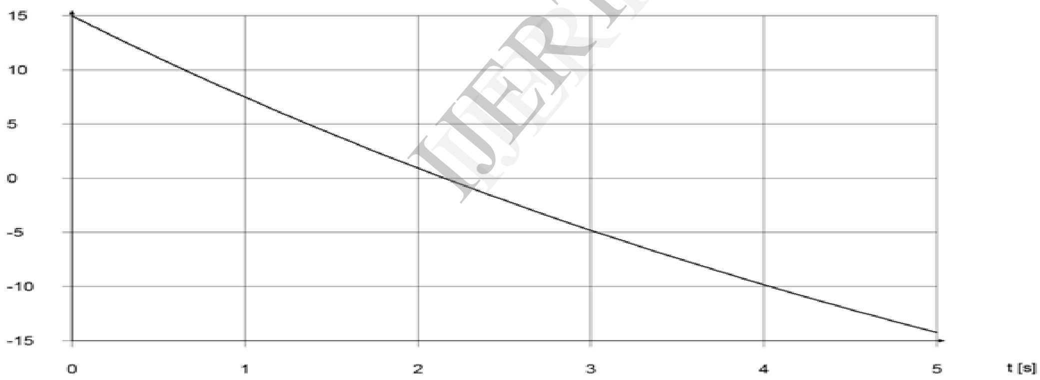
Simulation PV cycle:-

P(bar)

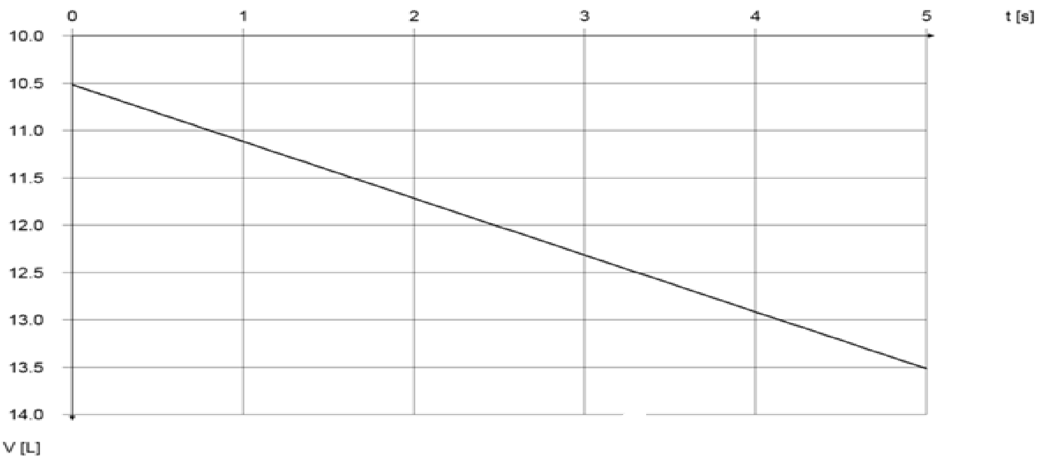


Simulation of Temperature:-

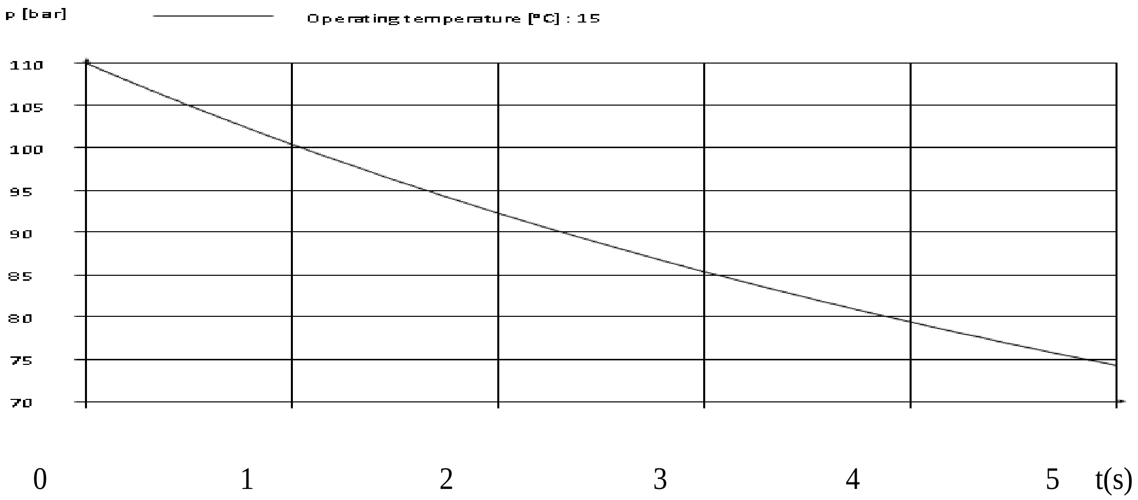
T(^{0}c)



Simulation of Discharge volume:-

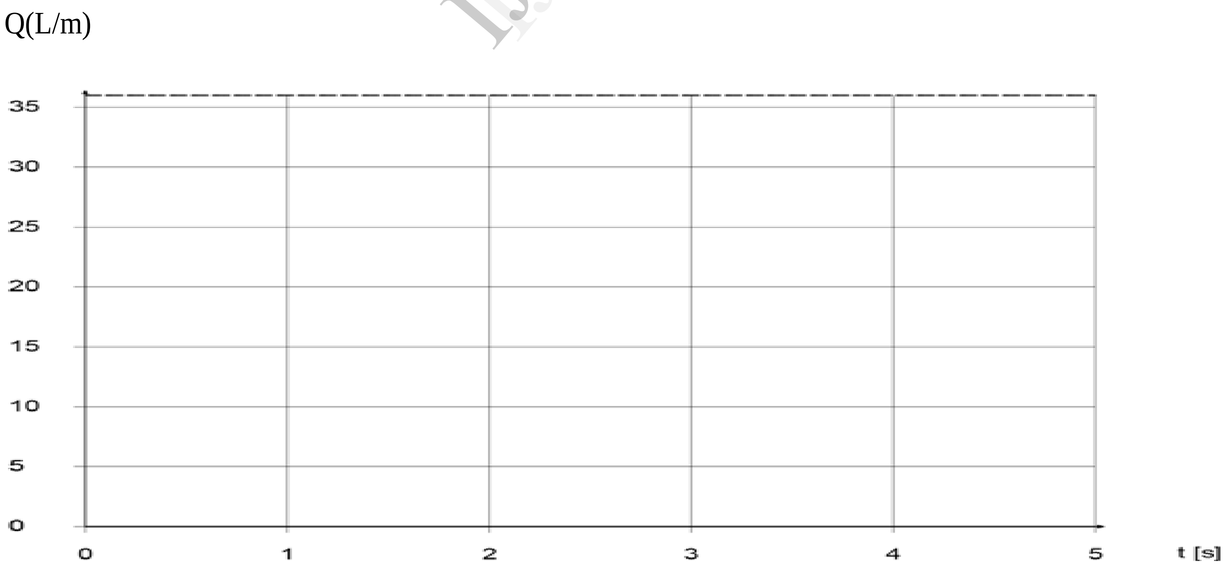


Simulation of Pressure:-



Simulation Actuation of Accumulator:-

NO.	Switch On Time		Switch Off Time		Flow Rate	Volume
	Min	Second	Min	Second	L/min	(L)
1	0	0.000	0	5.000	36.000	3.000



References

[1] Charles G. Oakes, Whole Building Design Objectives for Campus Safety and Security: A Systems Dynamics Approach, *Facilities Manager*, July/August, 2010, pp 21-26.

[2] Hydraulic Power System Analysis, A. Akers, M. Gassman, & R. Smith, Taylor & Francis, New York, 2006.

[3] E. John Finnemore, Joseph Franzini "Fluid Mechanics with Engineering Applications",McGraw-Hill,2002.

[4] Jean Mercier. "Patent for the Hydraulic Accumulator.

[5] Oil Hydraulic Systems: Principles and Maintenance, S. Majumdar..

[6] Francisco Olivera & David Maidment, "System for GIS-Based Hydrologic & Hydraulic Application for Highway Engineering.