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EVALUATING THE COOKING OIL CONTAINER FILLING MACHINE'S PERFORMANCE BY ALTERING THE ACTUATION DEVICES (EXPERIMENTAL METHODS)

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ABSTRACT

Modern process industries need to increase the efficiency of their current systems, run their plants at maximum capacity, and lessen the impact of a manpower shortage. Process industries use a tremendous amount of labor, and the only practical option is to automate the system. We have attempted to automate the edible oil drum filing machine in this study. As part of this effort, we first built an automatic drum filling equipment that could fill a 15 kilogram edible oil drum. Initial, we have trouble filling the drum precisely. We have been operated two single acting, pneumatically operated valves have been used for control. To attain the required level of precision, we have used a variety of approaches, including adding or altering components. To achieve accuracy, we performed a number of experiments, the specifics of which are presented in this paper together with the experimental set up and results. We utilize both electrically and pneumatically controlled control valves with accessories to achieve the required level of accuracy. We've concluded with some final thoughts that should help these kinds of current process industries works effectively.

Keywords: Drum Filling Machine, Pneumatic Control Device, Solenoid Valve

1. INTRODUCTION

The liquid filling machine is a semi-automated device that fills bottles and other containers precisely with liquid. These devices operate via gravity filling and an angle valve that is pneumatically actuated. It is a little device with a stainless steel pipe attached.

This drum filling machine also increases efficiency while decreasing product waste. It is skillfully made to meet your needs for liquid filling in modern industrial applications. It is appropriate for your hazardous environment due to its stainless steel construction. This easy-to-use drum filling machine helps workers set filling criteria for effective material management. Production goes up and product giveaway goes down. Its large, easily readable menu display is included, enabling quick setup.

The majority of liquid filling machines operate via positive displacement piston arrangements; occasionally, liquid is filled into containers using gravity force or hopper mechanisms. There are a wide variety of liquid machines available on the market. We have observed each type of machine and have made an effort to comprehend its behavior as well as its mechanism and working principle. Our goal is to design a liquid filling machine that is affordable, small, and easy for all users to operate. Weighing Based Drum Filling Machine is compact, Accurate, robust in design. It consists of a filling microcontroller, weighing platform and a dual stage filling valve.

We attempted to discuss the entire path and analysis of the fluid flow in the filling machine in this work. In order to maintain accurate operation with an optimal lead time, the automatic drum filling machine must have the necessary level of precision and the oil filling time must be as short as possible. This study presents an investigation of the pipe system's performance through control device alterations.

The following figure illustrates the filling machine control devices, the filling head assembly model, and the piping layout line diagram.

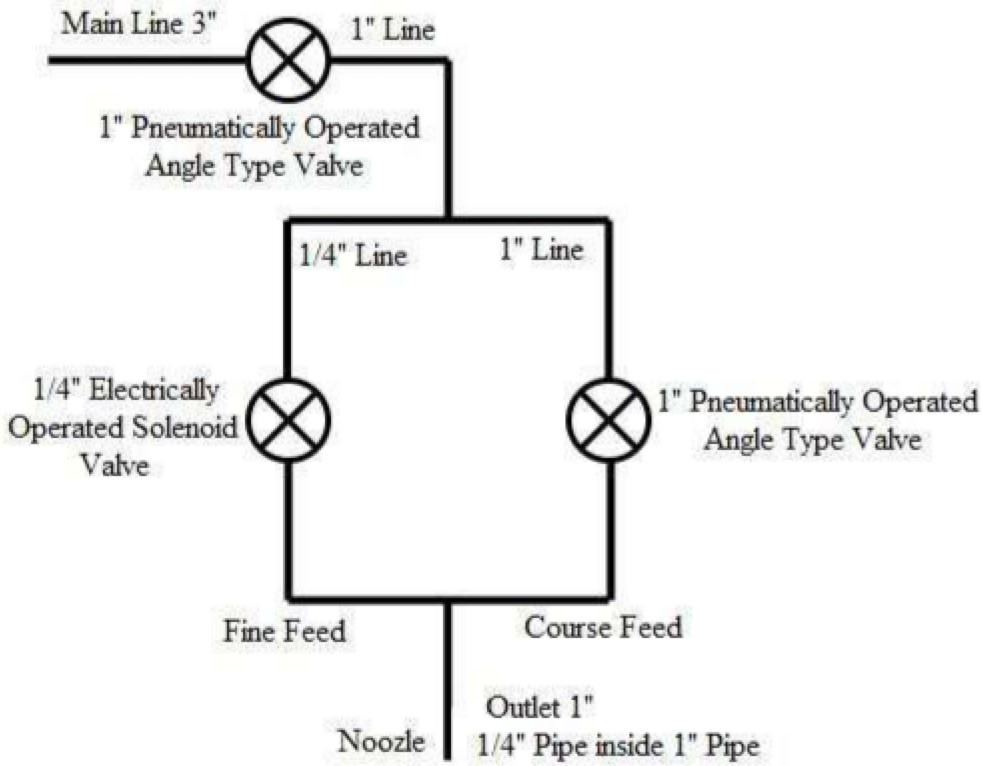


Figure 1: Filling Machine Piping Layout

The main line in the above diagram, which has a diameter of 3", is reduced to 1" by using a reducer. Next, a 1-inch pneumatically operated single-acting angle type valve regulates the flow of 1-inch pipe. The flow is then redirected for fine feed and course feed in both directions. The fine feed line has a ½" diameter, while the course feed has the same diameter of 1". An identical 1" pneumatically actuated single acting angle type valve, along with a quick release valve for quick valve response, makes up the course feed valve. A ½" electrically powered solenoid valve is installed in the fine feed line because it responds more quickly and has greater accuracy. Subsequently, both pipes are combined and positioned for the nozzle.

2. DESIGN CRITERION

From different market application we decided some criterion to develop a filling machine which is listed below.

1. It can be used for filling different types of non-foaming liquids like water, Edible Oil, Petroleum products, soap, Cold Drinks etc.
2. The Filling Machine can filled liquids which having different viscosity.
3. It can filled verity of filling drums like bottle, can, drum etc.
4. It having a nozzle opening and Flow rate according to normal market application.
5. The machine can be Filled drum which have variation in height.
6. There should not be dripping liquid after completion of the operation.
7. Machine require flexible controller which can be useful to switch from one product to another.
8. The materials of part fabrication which are in directly contact with liquid should be food grade, non explosive and non-reactive.

9. Selection of Load Cell for load cell table is dependent on the size of drum.
10. Filling machine should be leakage proof so it can be helpful to make working environment clean and minimize weast.

3. EXPERIMENTAL SETUP

The equipment needed for the experimental setup is as follows:

1. Base
2. Base Top Plate
3. Round Column
4. Stiffener Plate
5. Bottom Support Plate
6. 1” Angle Type Valve
7. 1/2 “Angle Type Valve
8. Piping
9. Moving Bracket
10. Pneumatic Cylinder
11. Top Plate
12. Adjustable Bar
13. Side Support
14. Top Support Plate
15. Bottom Plate
16. Guide Bar
17. Moving Flange Plate/ Valve Support Plate

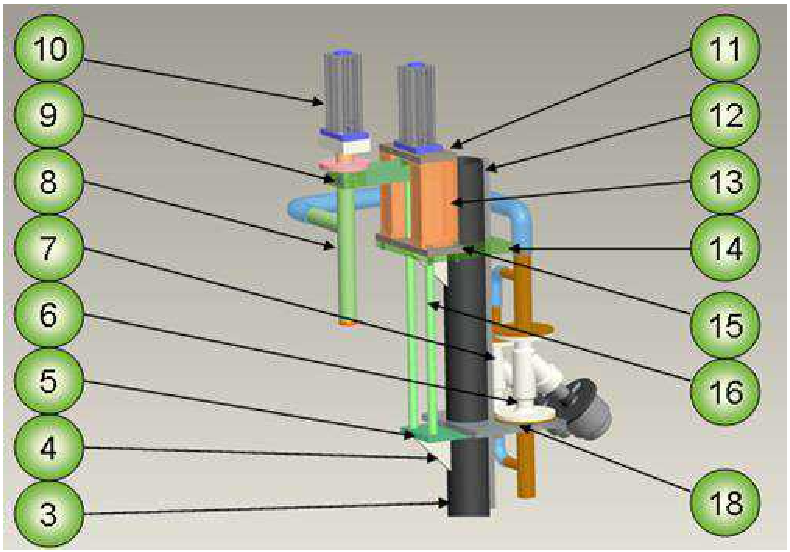


Figure 1: CAD Model of Experimental configuration

Figure 2: Experimental Setup

4. Measuring Accuracy with Experimental Methods:

We experimented with the prototype to regulate accuracy within the tolerance range. For this experiment, we have modified the equipment's flow control elements. For controlling the fluid flow, we were using setups on the equipment and data from the experiment. The following four conditions can be achieved by altering the flow control arrangement:

1. 1” – Pneumatically Operated Angle Type Valve

2. 2 Nos 1” – Pneumatically operated valves are Placed Parallel and ¼” – Solenoid valve placed for fine Feed.

3. 1” and ½” – Pneumatically Operated Valves are Used for Course and Fine Feed.

4. 1”- Pneumatically operated valve for course feed and ¼” – Solenoid valve for fine feed

1. 1” – Pneumatically Operated Angle Type Valve

We have only one valve available to us to control the fluid in this situation. That valve is a 1” Airmax India Limited single-acting angle valve that is pneumatically controlled. The experimental results regarding that condition have taken. Figure 3 displays the line diagram as follows:

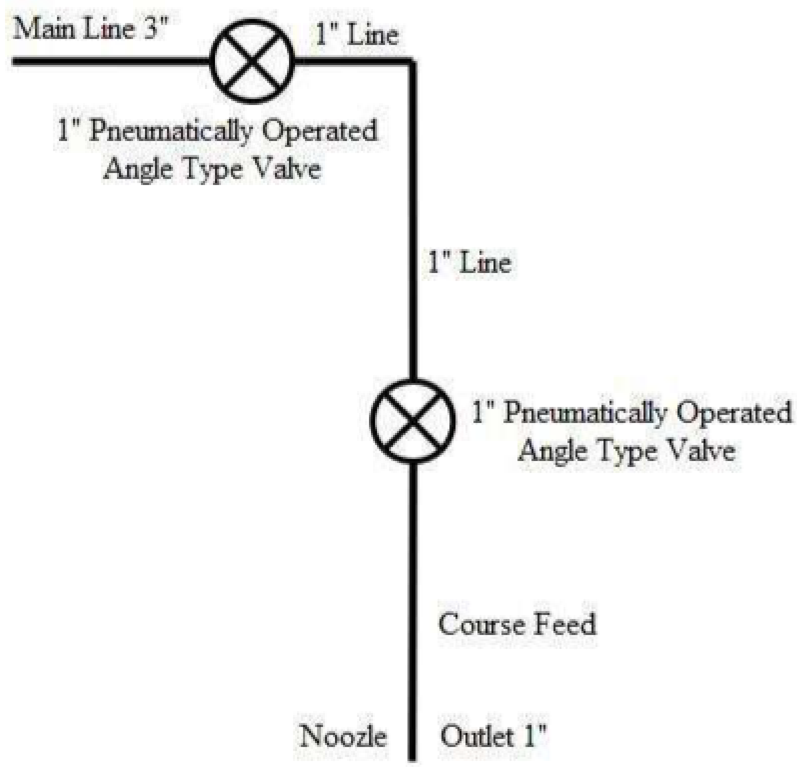


Figure 3: Condition 1: Filling Machine Piping Layout

Based on the aforementioned conditions, we conducted a variety of experiments. The results are shown in Table 1, and efficiency is derived from them.

Table 1: Experimental Results for Condition 1.

Parameter	Experiment No. 1	Experiment No. 2	Experiment No. 3	Experiment No. 4	Experiment No. 5
Filling Weight (kg)	15.164	15.122	15.084	15.170	15.112
Difference	0.164	0.122	0.084	0.170	0.112
% Accuracy	98.90%	99.18%	99.44%	98.87%	99.25%

2. Two 1" – Pneumatically Operated Angle Type Valve and ½" - Pneumatically Operated Angle Type Valve Placed Parallel

Three parallel valves have been used to regulate the fluid in this situation. Among these, two are 1" pneumatically operated single acting angle type valves, and the third is a ½" pneumatically operated single acting angle type valve from Airmax India Ltd. The experimental results for that condition have been given to us. Figure 4 displays the line diagram as follows.

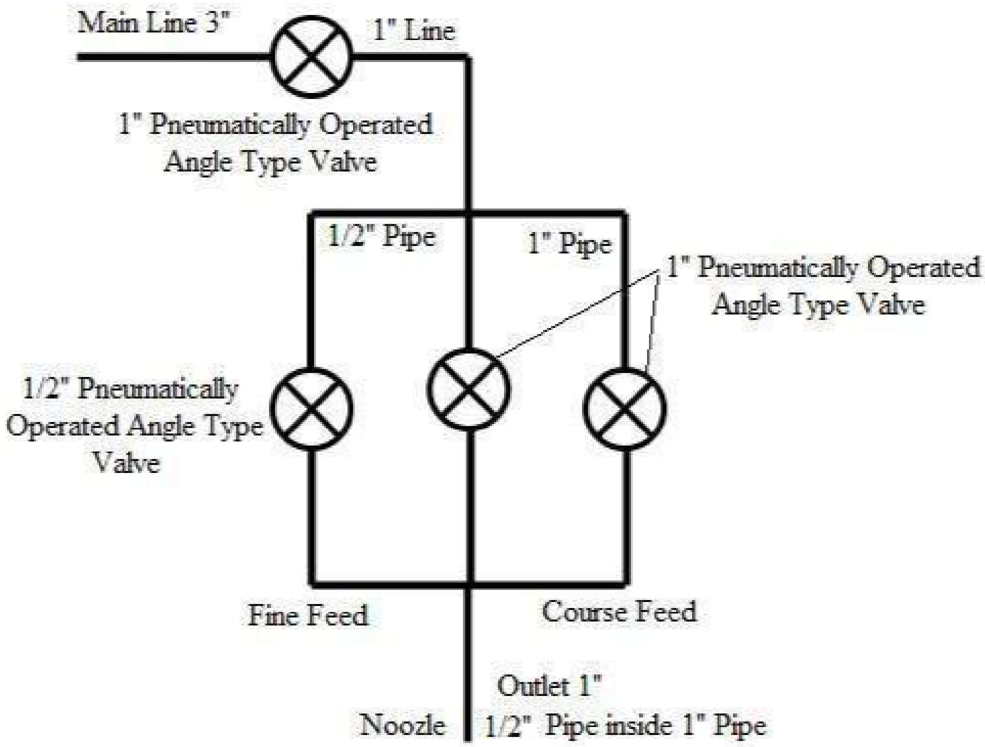


Figure 4: Condition **2:** Piping Layout for Filling Machine

Based on the circumstances mentioned above, we conducted a variety of experiments. The results are shown in Table 2, and efficiency can be determined from them.

Table 2: Experimental Results for Condition 2.

Parameter	Experiment No. 1	Experiment No. 2	Experiment No. 3	Experiment No. 4	Experiment No. 5
Filling Weight (kg)	15.200	15.125	15.080	15.175	15.100
Difference	0.200	0.125	0.080	0.175	0.100
% Accuracy	98.67%	99.16%	99.46%	98.83%	99.33%

3. 1" – Pneumatically Operated Angle Type Valve and ½" - Pneumatically Operated Angle Type Valve Placed Parallel

Two parallel valves have been used to control the fluid in this situation. Out of that one valve is of 1" – Pneumatically operated single acting angle type valve and second is ½" – Pneumatically operated Single acting angle type valve of Airmax India Limited. We have been taken experimental results for that condition. The line diagram is shown in figure 5 as follows

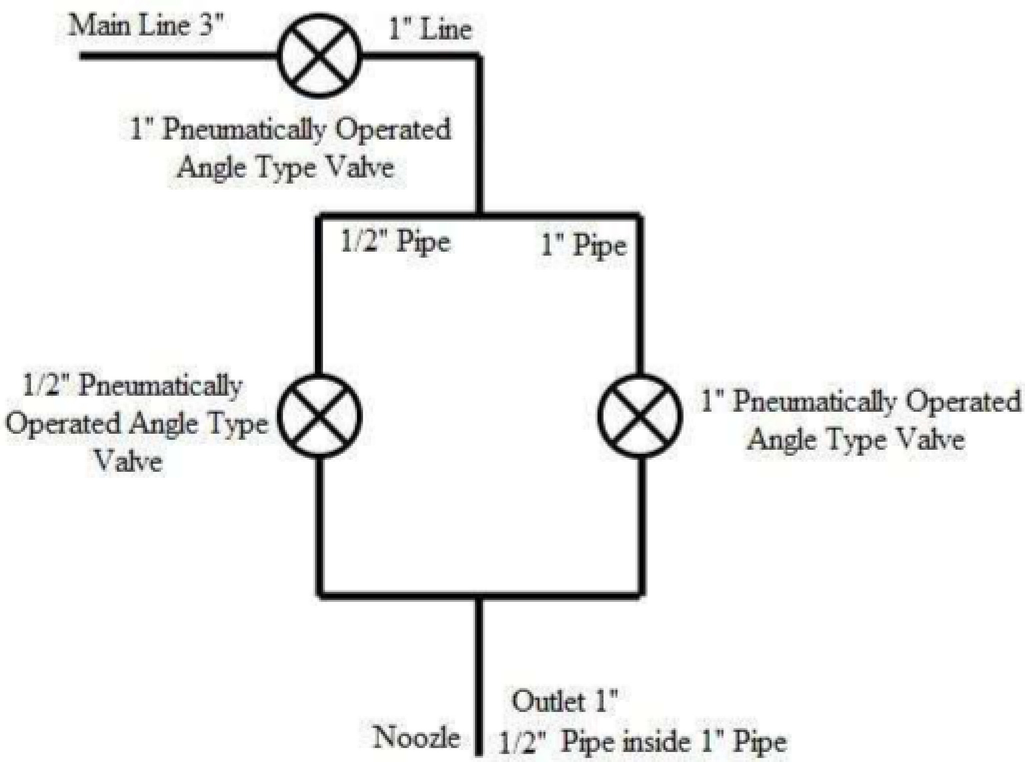


Figure 5: Condition **3:** Piping Layout for Filling Machine

We have carried out different experiments based on above condition and results are shown in table 3 and efficiency is derived out from that results.

Table 3: Experimental Results for Condition 3.

Parameter	Experiment No. 1	Experiment No. 2	Experiment No. 3	Experiment No. 4	Experiment No. 5
Filling Weight (kg)	15.090	15.038	15.000	15.038	15.040
Difference	0.090	0.038	0.000	0.038	0.040
% Accuracy	99.40%	99.75%	100%	99.75%	99.75%

4. 1” – Pneumatically Operated Angle Type Valve and ¼” – Electrically Operated Solenoid Valve

In this condition we have been taken three parallel valves for control the fluid. Out of that two valves are of 1” – Pneumatically operated single acting angle type valve and third is ¼” – Electrically Operated Solenoid type valve of Airmax India Limited. We have been taken experimental results for that condition. The line diagram is shown in figure 6 as follows

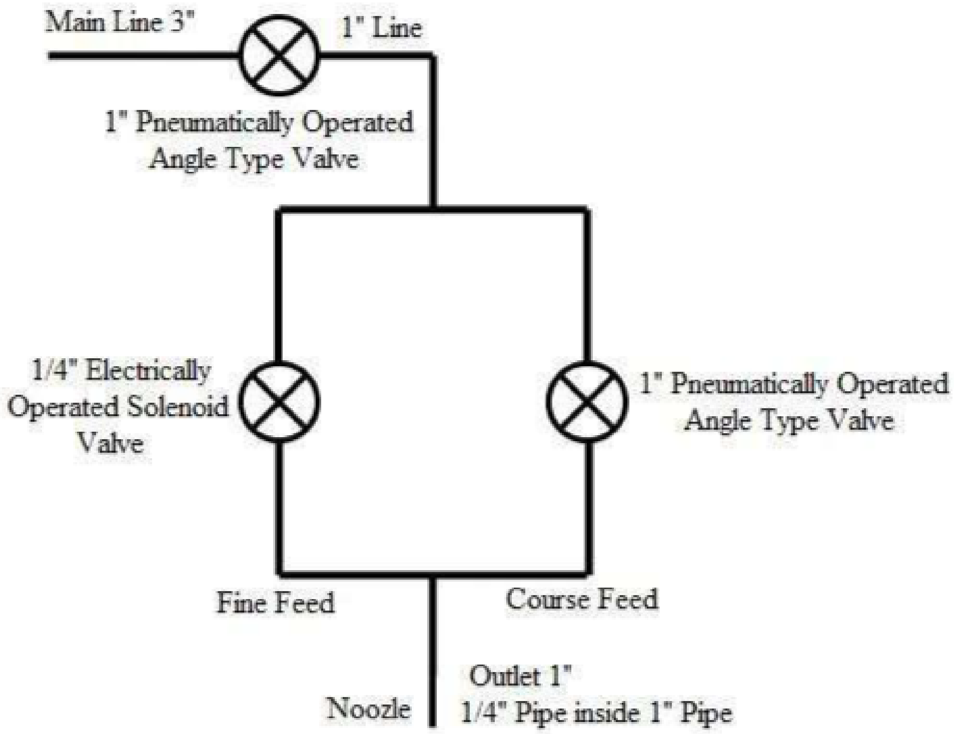


Figure 6: Condition **4:** Piping Layout for Filling Machine

We have performed different experiments based on above condition and results are shown in table 4 and efficiency is derived out from that results.

Table 4: Experimental Results for Condition 4.

Parameter	Experiment No. 1	Experiment No. 2	Experiment No. 3	Experiment No. 4	Experiment No. 5
Filling Weight (kg)	15.010	15.000	14.996	14.990	15.006
Difference	0.010	0.000	-0.004	-0.010	0.006
% Accuracy	99.93%	100%	99.97%	99.93%	99.96%

5. ANALYSIS OF RESULTS:

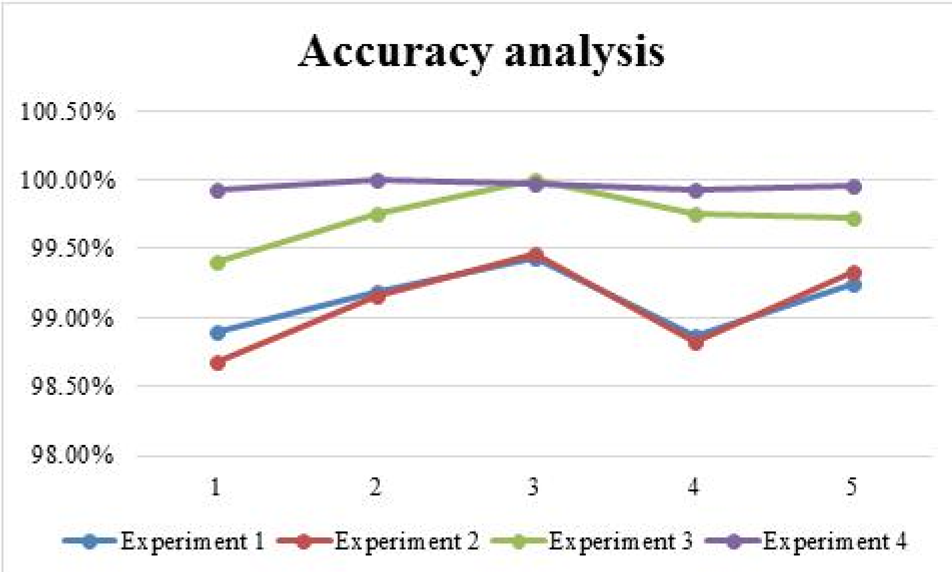
From all experiments with different conditions, following table shows the comparative analysis of the results taken by experimental methods by taking four different types of fluid control devices:

Table 5: Cumulative Experimental Results for All Conditions.

Sr. No.	1	2	3	4	5	Max	Min	Difference
Experiment 1	15.164	15.122	15.084	15.170	15.112	15.170	15.084	0.086
Experiment 2	15.200	15.125	15.080	15.175	15.100	15.200	15.080	0.120

Experiment 3	15.090	15.038	15.000	15.038	15.040	15.090	15.000	0.090
Experiment 4	15.010	15.000	14.996	14.990	15.006	15.010	14.990	0.020

The above results can also be presented graphically as bellow.



The above graph shows that the results in the experiment no 4 are accurate as well as consistent compare to other three experiments. The deviation in the results is minimum in last experiments. So by changing the control devices the 4th option is optimum and suitable for the filling of drum with better accuracy.

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