

Study development of method experiment LJGP which integrated technology arduino-uno and digital sensor with dimension of throat ratio 32,63mm

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Abstract

The data was good, fast and efficient on Liquid Jet Gas Pump (LJGP) is necessary to obtain the best conditions LJGP vacuum tool. The retrieval of data, manual calculation in this study are considered less effective because it takes a long time. It is therefore necessary for the development of research by integrating the tool LJGP with Arduino-uno technology and digital sensor that can be directly simulated in the computer. LJGP construction consists of a nozzle, section chamber, throat and diffuser. In this study, mean flow ratio is the ratio between primary flow and secondary flow, while the pressure ratio is different discharge pressure and suction pressure divided by the primary pressure reduced discharge pressure. The purpose of this study was to obtain research data efficiently and accurately can be directly simulated in the computer as well as to determine the effect of flow ratio of the pressure ratio at LJGP which functioned as a vacuum pump as well as its efficiency. The research method with experiments involving water fluid and air in the throat ratio is 32.63 mm, the observed data is the primary flow / motive flow is 0.32 L/s, up to 0.44 L/s and secondary flow ranged from 0.04 L/s to 0.2 L/s. The results of this study obtained data quickly, accurately, efficiently using Arduino-uno technology and digital sensor compared to manual data collection. On the other hand the test results using the dimension of 32.63 mm throat ratio obtained maximum efficiency of 10.69% on $Q_{\text{gas}} = 25$ scfh (0.566) in the liquid discharge 6 gpm. While the lowest efficiency is obtained upon discharge $Q_L = 10$ gpm with the efficiency of 8.89% and $Q_{\text{gas}} = 25$ scfh (0.415). The phenomenon of loss of efficiency due to the losses and the possibility of shock by wall in the fluid. Lowest vacuum level obtained in the discharge motive 6 gpm is equal to 187.995 Pa at 25 scfh measurement scale (0.000196 m³/s), while the highest vacuum is obtained at 10 gpm with motive flow is 257.909 Pa on scale of 25 scfh (0.000196 m³/s).

Keywords: LJGP, Throat ratio, flow ratio, arduino, digital sensor

1. Introduction

The data was good, fast and efficient on Liquid Jet Gas Pump (LJGP) is necessary to obtain the best conditions the level of vacuum equipment with appropriate and accurate process. The retrieval of data, manual calculation and visualization in graphs to solve equations in this study are considered less effective because it takes a long time. To overcome these conditions, the importance of the development of methods of research done by integrating the tool technology Liquid Jet Gas Pump with Arduino-uno and digital sensor MPX5100/5050 that can be directly simulated in the computer. This research is the development of the experiments that have been done earlier writer who has been funded by the higher education (Grant research of beginner lecturer of year 2015), which in a previous experiment data retrieval methods Liquid Jet Gas Pump (LJGP) done manually, so that the results obtained are less than optimum and takes long enough in the data collection and calculation equations equations processes and simulation in the form of graph.

While the experiment funded by the higher education research development is done with experimental data retrieval methods of digital data is loger, which is a method of integrating the appliance installation LJGP with Arduino - Uno hardware technology that is already connected to a digital sensor automatic MPX5100/5050. Study development LJGP system with digital sensor is expected to be increased, so that the experimental data obtained will be more quickly, efficiently

and accurately as a reference in designing the vacuum pump equipment that can be applied to the industry, specially for to middle small industry producers of processed snacks and fruit chips that utilize vacuum pump as the main equipment. LJGP are energy conversion devices that can divert the fluid air by utilizing water based fluid pressure difference between the two fluids without the use of moving parts. Besides being able to drain the fluid in various phases, LJGP has a simple design and small dimensions so the installation is easy and cheap. LJGP design consists of four main parts: throat, nozzle, suction chamber, and diffuser. One of the main important part is the throat, where the throat is a place where the process of changing the pattern of the jet stream to fronth flow, the pressure increases, and slowing the flow rate, so that the dimensions of the throat is likely to affect the performance in Liquid Jet Gas Pump.

Arduino is a physical computing platform that is open source which Arduino has an input/output (I/O) is simple and can be controlled using a programming language. Arduino can be connected to peripheral like computers. The programming language used on the Arduino is the programming language 'C' that has been simplified with the features in the library so it is quite helpful in making the program. There are two main parts to the Arduino, namely hardware and software. Hardware arduino an electronic board which is called by the microcontroller while the arduino software that is used to enter a program that will be used to run the arduino. The programming language used is language 'C' in the open-

source Arduino environment makes it easy to write code and upload it to the Arduino board, this tool runs on Windows, Mac OS X, and Linux. Based on Processing, avr - gcc, and other open source software.

The sensor is a type of transducer used to convert the amount of mechanical, magnetic, heat, light, and chemicals into a voltage and electric current. Sensors are often used for detection at the time of measurement or control. Several types of sensors are widely used in electronic circuits include a

pressure sensor, temperature sensor, light sensor, and a humidity sensor. Pressure sensor MPX5100 series is a type of sensor that can be connected to the Arduino technology, this sensor uses supply voltage of Arduino which is an electronic board or open source electronic circuit board in which there is a major component of which is a chip microcontroller with the type of firm Atmel AVR. The microcontroller itself is a chip or IC (Integrated Circuit) that can be programmed using a computer.

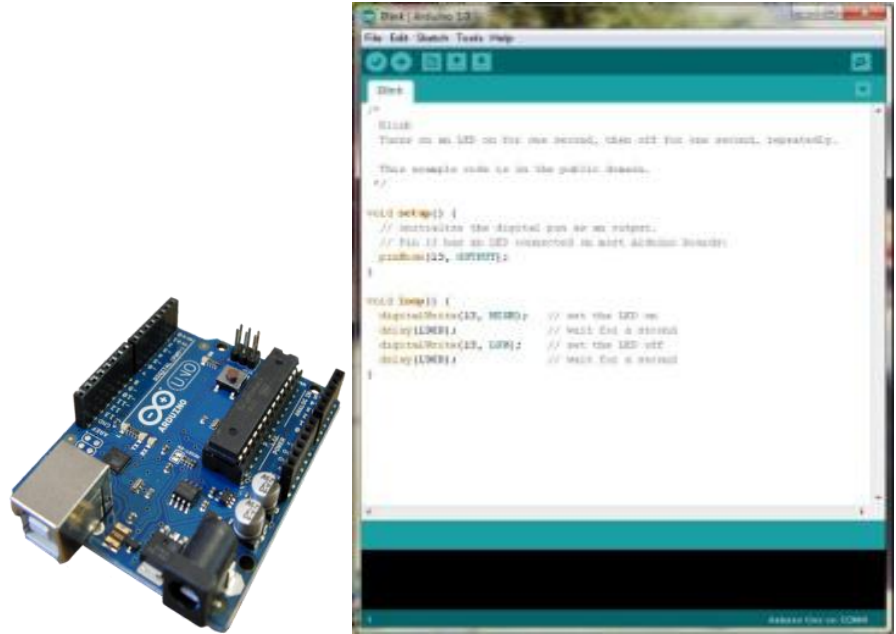


Fig 1: Physical appearance and Framework Arduino

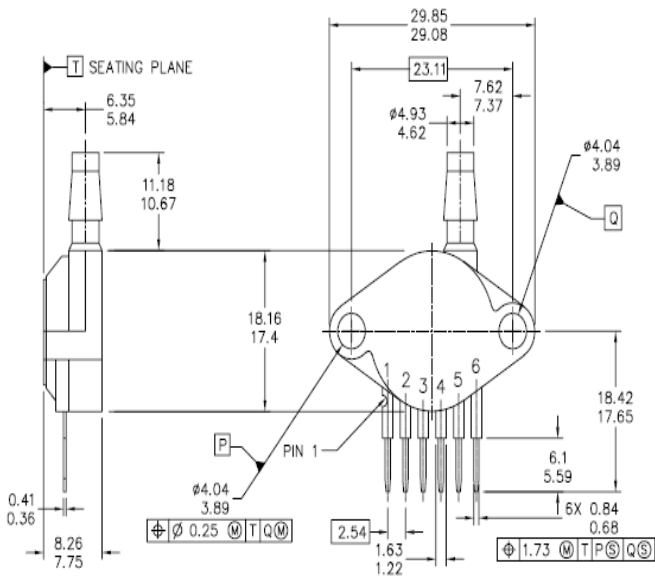


Fig 2: Pressure Sensor MPX5100 series

Throat functioned as the venue after the energy conversion occurs on jet entrainment. In the throat of intervention, namely gas flow patterns continue into liquid continue. This pattern changes caused by the exchange of momentum between the flow (Witte, 1969)

In the simulations that have been carried out by Yadav and Patwardhan (2008), found that throat optimum length is 4 times the diameter of the throat. While Sugati.D (2008)

conducted a study on the characteristics of the jet pump which functioned as a vacuum pump. The results showed that the primary pressure / high motive tends to give better efficiency

According Winoto (2000), the efficiency of the jet pump nozzle is affected by the cross-sectional shape. With a wide cross-section; triangles, rectangles, and circles jet pump maximum efficiency is obtained in the form of circular cross section. The efficiency of the jet pump is influenced by a variety of conditions from the nozzle.

The purpose of this study was to obtain research data efficiently and accurately can be directly simulated in the computer as well as to determine the effect of flow ratio of the pressure ratio at LJGP which functioned as a vacuum pump as well as its efficiency.

2. Experimental Setup and Procedure

The research method with experiments involving water fluid and air in the throat ratio is 32.63 mm, the observed data is the primary flow rate/ motive flow is 0.32 L/s until 0.44 L/s and secondary flow ranged from 0.04 L/s to 0.2 L/s. In this study using Liquid Jet Gas Pump (LJGP) installation circuits have been installed with Arduino - Uno and digital sensor, as shown in Figure 3 subsequent to the end of the study making a correlation with the results of previous studies. In general, there are four main stages in the study authors, these stages, namely the preparatory stage, the stage of calibration, testing and completion.

Table 1: Experiment Conditions

Conditions	data
Throat length, $L_T = 3.75$ (mm)	$3.75d_T$; or
Throat diameter, $d_T = 8.7$ mm	32.63 mm
Secondary flow (SCFH)	0 - 30
Motive flow (GPM)	6, 7, 8, 9 and 10

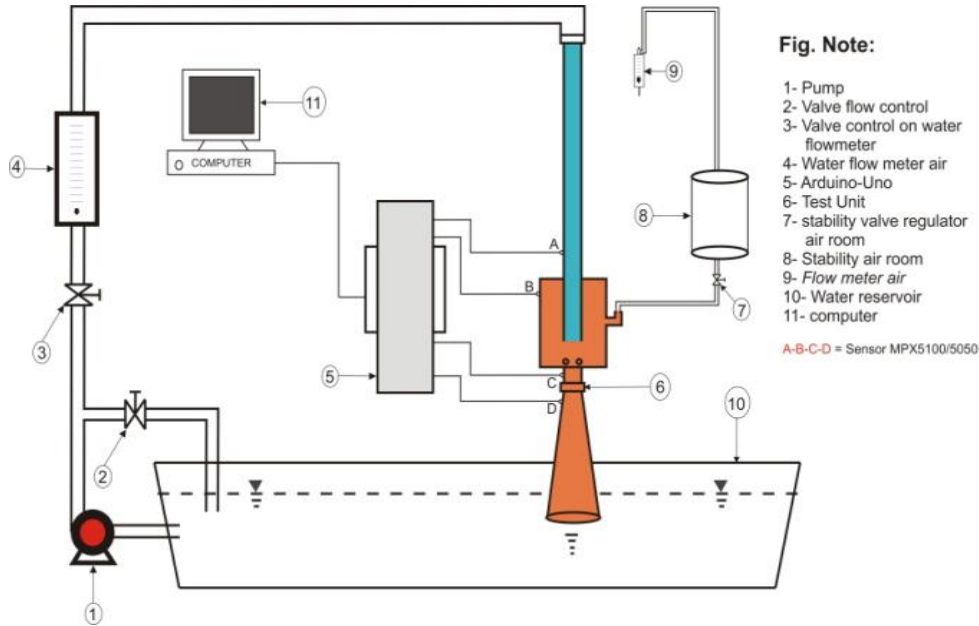


Fig 3: Experimental set up

3. Results and Discussions

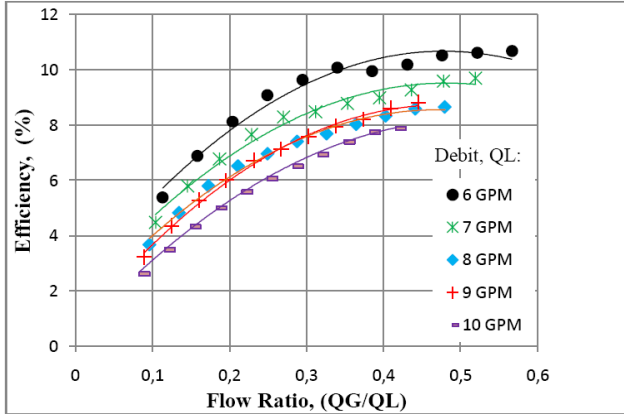


Fig 4: Graph relation flow ratio to efficiency with liquid flow rate (6, 7, 8, 9 and 10 gpm) at throat ratio of 32.63 mm.

The observations set forth in Figure 4 shows a graph of flow ratio on the efficiency with variations debit motive liquid stream: 6,7,8,9,10 gpm at 32.63 mm or throat ratio $L_t = 3,75d_t$. Based on the measurement data / observations using the data logger arduino connected with digital air pressure sensor MPX5100/5050 and the processing of data as outlined in the chart Figure 4, shows that the same phenomenon tends to occur on the variation of the flow rate motive given in each data collection. In the simulated data processing in this chart is seen that the result of the income stream on the motive that is 6 gpm flow generating maximum efficiency is equal to 10.69% in $Q_{gas} = 25$ scfh (0.566). Whereas for the same condition, namely the discharge of motive (7 gpm) shows that the maximum efficiency was 9.70% at $Q_{gas} = 25$ scfh and

successively on condition results others are debit motive at $Q_L = 8$ gpm efficiency maximum obtained are 8.66% in the conditions $Q_{gas} = 25$ SCFH, $Q_L = 9$ gpm efficiency gained 8.84% with $Q_{gas} = 25$ scfh and $Q_L = 10$ gpm generating efficiency of 8.89% with $Q_{gas} = 25$ SCFH (0,414). In general all the conditions laid down in the chart Figure 4 is a picture of the phenomenon of constant throat dimension (32.63 mm or $L_t = 3,75d_t$). Test and measurements made using a data logger connection digital sensor with arduino hardware. With automatic digital equipment is the measuring process can be done quickly and efficiently, thus saving time and cost in the process of data collection in the field. The results of the measurement data with automatic systems of data logger obtained phenomenon is not much different to that obtained when using manual measurements, only use the data logger automatic higher level of effectiveness.

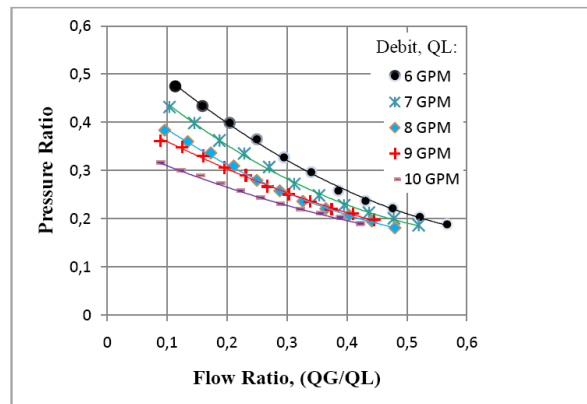


Fig 5: Graph relationship between flow ratio and pressure at throat ratio 32.63 mm.

From the test results and data processing are shown in Figure 5, namely relations flow ratio against the pressure ratio, a tendency on any given motive discharge phenomenon form not much different from the other motive flow. Phenomenon in figure 5 shows that increasing the flow ratio causes a decrease in pressure ratio motive so consequently the flow rate to decrease. The reduced flow rate this motive causes vacuum pressure decreases and increases motive pressure (the pressure ratio decreases).

In Figure 6 the pressure flow analyzed are the primary pressure (pressure motive) and a secondary pressure (vacuum pressure). The primary pressure is the pressure of the fluid (water) generated by the pump, to further flow into LJGP

passing through the nozzle. This primary pressure is positive. From the observation, as shown in Figure 6 is seen that the changes in the secondary flow rate at a certain value leads to changes in the primary pressure greater than the primary pressure before and after the secondary flow rate is reached. Such changes occur at the time of the break-up length (effective length of the jet before it broke) is reached. Break-up length influenced by the flow rate of the secondary (Bin A.K, 1987). From processing the data presented in Figure 6 that have patterns with the same trend on each secondary infusion flow rates are given, with increased flow rate secondary to discharge the same motive led to increased pressure motive.

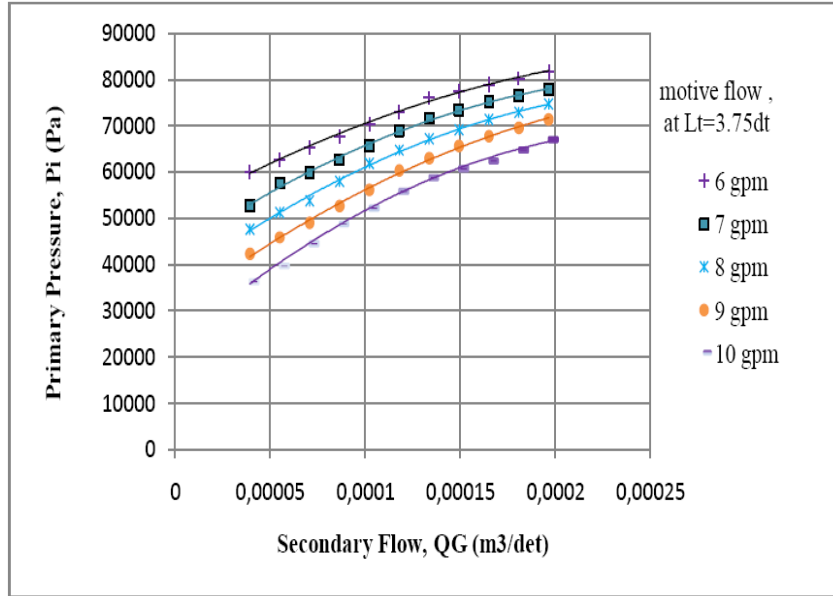


Fig 6: Graph relationship between secondary flow with primary pressure on the throat ratio 32.63 mm.

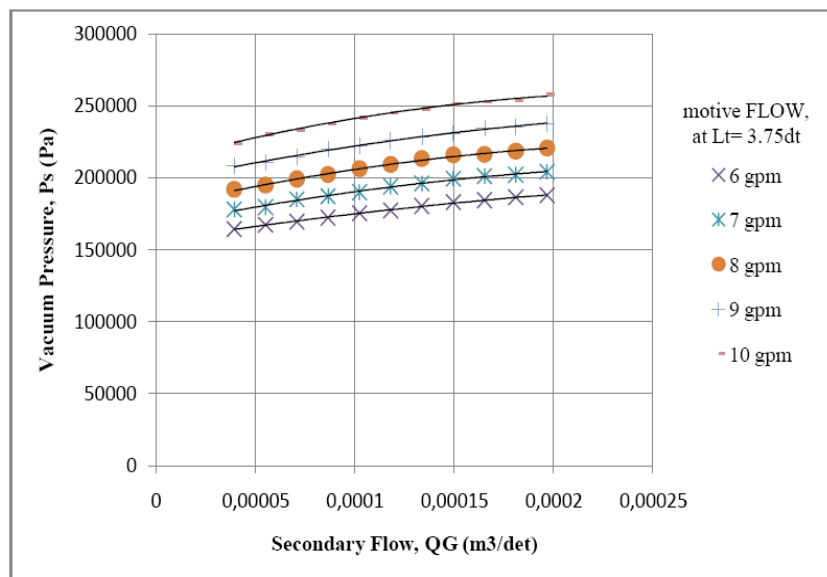


Fig 7: Graph relation secondary flow with the vacuum pressure in the throat ratio of 32.63 mm

The analysis can be explained from Figure 7 is that when given input secondary flow rates of then the primary flow rate also varied. The measurement results using arduino integrated with digital sensor was found that the air pressure, the method

is very good and effective in the measurement process to obtain data quickly and accurately. From Figure 7 it can be seen that the lowest level of vacuum obtained in the discharge motive 6 GPM is equal to 187.995 Pa on the

measurement scale 25 scfh or 0.000196 m³/s, while the highest vacuum is obtained at 10 gpm motive flow is 257.909 Pa on scale of 25 scfh or 0,000 196 m³/s. From this analysis to inform that the increasing of primary flow/motive flow given cause high vacuum conditions and so conversely the smaller flow rates given primary vacuum conditions are also getting smaller.

4. Conclusion

The results of this study obtained data quickly, accurately, efficiently using Arduino - uno technology and digital sensor compared to manual data collection. On the other hand the test results using the dimensions of 32.63 mm throat ratio obtained maximum efficiency 10.69% on $Q_{\text{gas}}=25$ scfh (0.566) in the liquid discharge 6 gpm. While the lowest efficiency is obtained upon discharge $Q_L=10$ gpm with the efficiency 8.89% and $Q_{\text{gas}}=25$ scfh (0.415). The phenomenon of loss of efficiency due to the losses and the possibility of shock by wall in the fluid. Lowest vacuum level obtained in the discharge motive 6 gpm is equal to 187.995 Pa at 25 scfh measurement scale (0.000196 m³/s), while the highest vacuum is obtained at 10 gpm motive flow is 257.909 Pa on scale of 25 scfh (0.000196 m³/s).

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