| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 6.392|

|| Volume 9, Issue 4, April 2020 ||

An Automatic Salt Content Remover (AASCR) in HDPE Hose

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ABSTRACT: India has been the backbone for the Agricultural field. Even Indian economy is majorly depending upon the field of agriculture which supports nearly 18.1% of India's country GDP. In India, mostly Kharif Crops are being cultivated depending upon the monsoon period. To gain the proper growth rate of Kharif Crops, Irrigation plays a vital role. Nowadays, the source for irrigation is certainly borewell water used by the Farmers. Most of the farmers use Compressor-based borewell to pump the water into the land. While using the Compressor-based borewell, the hose walls are formed by Scaling or Salt Contents. This results in forming the barrier to the flow of water in High-Density Polyethylene (HDPE) hose and hence the operating time of the compressor and consumption of electrical energy are increased. The proposed idea introduces an assistant system named as An Automatic Salt Content Remover (AASCR) to the farmers to remove the scaling content in hoses of borewell. This proposed system also makes all the farmers from the conventional method of removing scaling such as replacement of hose which leads more cost.

KEYWORDS: Compressor-based borewell, Scaling content, HDPE Hose

I. INTRODUCTION

Agriculture, with its allied sectors, is unquestionably the largest livelihood provider in India, more so in the vast rural areas. It also contributes a significant figure to the Gross Domestic Product (GDP). 52% employment is being provided by Agriculture and its related products. As India holds the second largest place in the agriculture field, Agriculture Export Policy has set a target to increase agricultural exports to over US$ 60 billion by 2020. Government of India is also aiming to double Farmer's income by 2022. Generally, farmers are harvesting the crops at the regular interval. To cultivate and harvest the crops, most of the farmers are depending upon the natural source certainly water. Water resource plays a vital role among the farmers to make them so comfortable in farming. Sometimes, improper water management is another problem affecting India's agriculture. At a time of increasing water shortages and environmental crises, for example, the rice crop in India is allocated disproportionately high amounts of water. One result of the inefficient use of water is that water tables in regions of rice cultivation, such as Punjab, are on the rise, while soil fertility is on the decline. As water is the primary resource for farming, Farmers are seeking the place such as Borewell, lake, pond, canal etc.

Nowadays, Borewell is right source as all other sources of water are being depleted daily. Farmers are generally preferring both Pumping motor and Compressor-based Borewell in their agricultural land for the purpose of irrigation. While adopting the Compressor-based Borewell, the High-Density Polyethylene (HPDE) hoses are being affected by the phenomenon Scaling or Salt Content. Due to the regular use of Borewell, the scaling and sediment density are increased inside the water hose which results in affecting the flow of water content in it. Scaling and sedimentation are formed due to deposition of the ions, minerals, sand, clay and salt contents. These phenomena increase the pressure in the walls of the hose results in imbalance force inside the hose. Due to salt and mineral content, the pressure inside the wall is raised and the velocity of the flow is decreasedby Bernoulli's theorem.

Moreover, the presence of scaling and sedimentation content increases consumption of the electric power as well the time to pour the amount of water required by the land. To come out of these problems, farmers have to remove the contaminated salt contents inside the hose. But, in a real time, removal of scaling content is a difficult task to the farmers. Conventionally, the farmers are taking the hose out and cleaning the same by manual method. This process is repeated periodically based on the salt content formation inside the hose. In order to avoid the above said manual difficulties and interventions, the proposed system gives the feasible solution to the farmers.

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II. EXISTING SYSTEM

The existing system has three methods of removing the scaling content from the hose of the Borewell.

2.1 Removing Scaling Content – Method 1

In this method, the water hose is removed by farmers from the Borewell and filled with concentric acids and then allowed to wet condition for two or more days in sunlight. Having the hose reached the wet condition, they take and knock the hose with the wooden materials. Due to the concentrated acid and the knocking, the scales inside the hose is broken. The broken scales are taken out by laying the hoses inclined. This will take three to four days for cleaning purpose alone. It also requires man power to knock the hose. An uneven, extra pressure on the hose due to knocking may leads to break the hose. This way of cleaning leads the proper removal of scaling from the hose. Despite it has merits, it requires man power and more time based on the length of the hose.

2.2 Removing Scaling Content – Method 2

This is another conventional method to clean the hose. In this method, the more concentrated acids are poured into the hoses keeping inside the borewell. Then, the borewell water will get wasted until the acid contaminations are removed from the hoses. The broken scales are deposited under the hose and get contaminated to the ground water. The scales are not taken outside from the hose. This method has merits that salt content is removed without taking the hose from the Borewell and does not require much time for cleaning. Even though it has merits, ground water contamination is not at all eliminated.

2.3 Removing Scaling Content – Method 3

In this method, the farmers are replacing their hoses. The whole borewell hose is taken out and replaced with new one. This is more expensive method compared to others.

III. PROPOSED SYSTEM

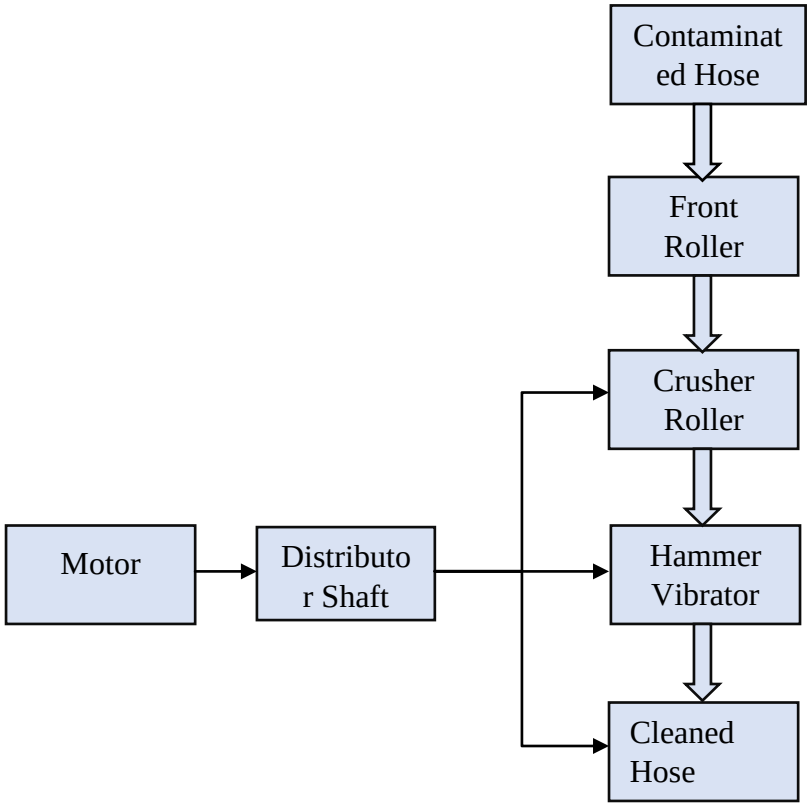

Fig 1. Block Diagram of Proposed System

The proposed system consists of Front Roller, Crusher Roller, Hammer Vibrator, Motor, and Distributor shaft.

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3.1 Front Roller

This front roller is used to bent the hose at the right proportion. At first, the hose is allowed under the front roller. When the hose is allowed into the system, it is inclined at a particular angle between the crusher and the front roller. At the time of bending results in the cracking of the scales. When the hose is bent more than a particular angle, it will lead to break the hose. Hence, it has to be bent carefully without breaking the hose. The roller is made up of mild steel and it is fixed using steel plates.

Fig 2. Front Roller

3.2 Crusher Roller

This roller is mainly used to crush the scaling contents in the hose. This crusher roller is welded with the steel shafts and attached in the mild steel plate using the bearings. At the end of the roller shaft, sprockets are welded for the rotational motion transmission purpose. The hose can withstand up to 1400°C, and pressure ratio is about 3:1. The density of the material is 0.93-0.97 g/cm3. The hose carefully fitted between the roller within the prescribed limit of pressure. The distance between the rollers can be adjustable as per the size of the hose. In general, the farmers are using 1.25 – 2.0-inch hoses in their agricultural land. Hence, the rollers should be adjustably fixed. Once hose is fixed with the roller, it is need not to adjust roller any more. The hose may be not in uniform shape for that the rollers must be suitably welded in order to break all the scaling contents.

Fig 3. Crusher Roller

Fig 4.Fixing Mild SteelPlates

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|| Volume 9, Issue 4, April 2020 ||

3.3 Hammer Vibrator

After crushing the hose, in between the roller setup, the hose is allowed to the Hammer Vibrator setup. In the vibrator portion, a rubber hammer is used. The vibrator is arranged by using camshaft setup, springs and handle.The rubber hammer knocks the hose. At the knocking stage, the minute particles are broken into pieces. Then, the broken scales are taken out from the hose by making it at some inclination setup.

Fig 5. Rubber Hammer

3.4 Motor and Distributor Shaft

The whole mechanism is driven by single phase induction motor rated at 0.5HP. A main sprocket is attached to the motor shaft. Another distributor shaft is used to run the whole machine. The distributor shaft is attached to the system using the mild steel plates and bearing setup. In the distributor shaft, three more sprockets are welded to operate the machine. One sprocket is used to receive the rotational motion from the main sprocket. The second sprocket is used to run the crusher roller and the third sprocket is used to operate the vibrator setup.

Fig 6. Electric Motor

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Fig 7. Distributor Shaft with Sprocket

3.5Working Principle

The whole hardware system is actuated by a singlephase Induction Motor by Main sprocket. It drives the Distributor Shaft through Chain. The crusher roller is rotated by connecting the distributor shaft and the roller using the sprocket and chain. The roller crushes the hose and breaks the salt. After this, the hose is passed to rubber vibrator setup for knocking the hose. The knocking arrangement is actuated by the cam shaft setup which is driven by the distributor shaft. After knocking the hose, it is allowed to pass outside the system. At the time, the salt particles inside the hose is completely removed by using either the high-pressure water or by utilizing the air compressor. Then, all the scaling contents are removed from the hose. Afterwards, the cleaned hose can be reinserted into the borewell and tied up with the compressor air hose and can be used as usual.

IV. CALCULATIONS, RESULTS AND DISCUSSIONS

The Efficiency in Mechanical Pump is calculated using the following terminologies:

Hydraulic power $P_H = Q\ g\ \rho\ H / (3.6 \times 10^6)$ W

Where,
Q – Rate of flow of liquid in m^3/h
g – Gravitational constant (9.81 m/s^2)
H – Total developed height in m
ρ - Density of the liquid in Kg/m^3

By Bernoulli's statement, the rate of flow in the hose varies by varying the head of discharge and also by varying the pressure of the hose. In this, hydraulic power is treated as the output power of the pump and the shaft power obtained from electric motor is treated as the input power of the pump keeping all the electrical losses are neglected. The sample calculation is described below.

Hydraulic power (P_H) = Shaft power (P_s) x Efficiency of pump
The shaft power of pump = 5 Hp
The efficiency of the pump lies between = 60 to 85%
Taking 80% as efficiency of the pump = 0.8
Hydraulic power output = 5 Hp x 0.8
P_H = 4 Hp (or) 2984 W*(Shown in Table 1)*

Table 1. Calculation of Efficiency using Rate of Flow of Liquid

Rate of Flow of Liquid Q in (m^3/h)	Hydraulic Power in (W)	Efficiency of Pump in (%)
0.9248	373	10%
1.849	746	20%
2.774	1119	30%
3.699	1492	40%
4.624	1865	50%
5.549	2238	60%
6.474	2611	70%
7.4	**2984**	**80%**
8.323	3357	90%

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|| Volume 9, Issue 4, April 2020 ||

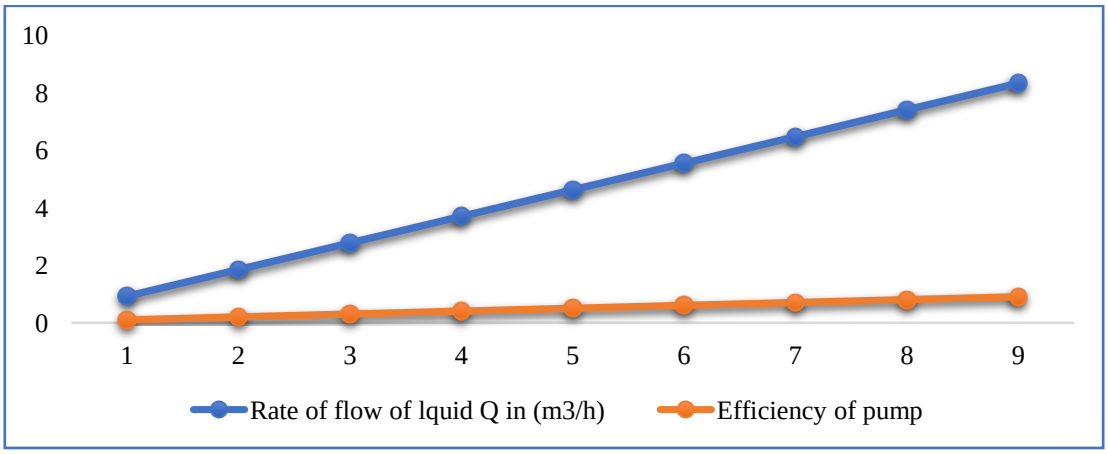

Fig 8. Efficiency Vs Rate of Flow of Liquid

V. CONCLUSION

As the technological developments rule the world, the product development related to Agriculture would facilitate the farmers in the world. The proposed ***Automatic Salt Content Remover*** would help the farmers in such a way that they could remove the salt contents in HDPE hose with minimum time. This results in avoiding the unwanted electrical energy consumption by means of operating the compressor. This automatic system would definitely help to the farmers who have been more struggle in removing the salt contents in the hose of the Borewell.

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