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MAGNETIC TREATMENT OF WATER FOR INDUSTRIAL USE IN BANGLADESH

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Abstract: ENEFLOW magnet is widely used in developed countries in softening industrial water as well as in improving burning efficiency of fuels like diesel, petrol, kerosene etc. through clustering and thereafter removing the suspended and dissolved solids of the liquid. In Bangladesh ENEFLOW magnet has been first imported and used in 2004 by DBL Group and then started the marketing to other industry. In 2012 five industries including DBL Group has found to use ENEFLOW magnet and proven economic and environmental benefit has said to be achieved by them. The present study was conducted to investigate the efficiency of the ENEFLOW magnet in removing hardness from the water used in textile printing and dyeing industries in DBL group and Multifabs Ltd. Bangladesh. The water samples before entering and after passing ENEFLOW magnet was collected and tested the PH, TDS and hardness in the laboratory. Study showed that TDS is removed up to 11 % and hardness is removed up to 17% and PH was found to get more neutral. Study also showed that removal of scale build-up on a heat exchange surface has found up to 70%. Several study showed that removal of scale build-up on a heat exchange surface where even a thin film of 0.8 mm can increase energy efficiency by nearly 10%. So the study concluded that use of ENEFLOW magnet is economically viable and environment friendly and can enhance industrial development in recent green economic concept. Further study should be conducted to investigate the economic benefit of using ENEFLOW magnet in energy efficient industrial operation.

1. INTRODUCTION

Combined with today's growing demand on the natural sources, water treatment has become one of the major problems in industrial applications, power production and water supply. With this increased demand, coupled with today's escalating costs of energy, industry cannot afford to waste energy. An effective water treatment program can provide substantial savings in both production time and costs. When any heat-transfer surface becomes scaled, this insulating scale reduces the efficiency of the equipment, increases fuel requirements and maintenance. Thus, there is an ever increasing demand for effectively treating water, not only economically, but to insure the minimum environmental pollution attainable. Natural water usually contains dissolved calcium and magnesium salts. Based on the content of Ca and Mg ions fresh water can be divided into hard water (high content of Ca and Mg ions) and soft water (low content of Ca and Mg ions). The limescale problem in hard water arises because the solubility of $CaCO_3$ decreases with increasing temperature.

Scale deposits by natural waters often lead to numerous technical and economical problems in industrial plants and domestic equipment by blocking the flow of water in pipes or limiting heat transfer in heat exchangers (Legrand and Leroy, 1990). Traditional chemical methods for scale control are effective but significantly change the solution composition and expensive.

History of scientific research regarding the influence of magnetic field on passing fluids dates back to 1831 and concerns mostly experiments made by Michael Faraday and James C. Maxwell. Faraday discovered that water flowing past a conductive material will generate a weak electrical charge. However non-chemical water treatment devices were first proposed as a means of scale control in 1865 (Cowan and Weintritt, 1976). In 1873, A.T. Hay received the first US patent for a water treatment device that employed a magnetic field.

As up to now there are only a few reports on scientific proof of the efficiency of magnetic treatment of water in literature and a common understanding as to what happens to water in the magnetic field is lacking, this method is often met with scepticism (Szkatula, et. al. 2002) On the other hand, such equipment is on sale and the users claim that magnetic devices are beneficial for controlling the formation of scale (Anon, 2012).

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However in Bangladesh the magnetic treatment of industrial and residential water in removing hardness and in controlling scale on the surface of heat exchanger is still behind the door to many of us. And the scientific investigation in this regard is far beyond. From this point of view the present work was conducted to investigate the efficiency of ENEFLOW magnet in removing scale from boiler through the removal of Ca Hardness and TDS from water was investigated.

2. METHODOLOGY

The study was conducted in Mymun Textile Ltd. (hereafter MTL) and Hamza Textile Ltd. (hereafter HTL) of DBL Group and in Multifabs Ltd. A common boiler unit has been installed to facilitate steam supply both in MTL and HTL Ground water is the only source of water consumption for all the studied industries. The ground water is previously soften using softener (different chemical reagents). On the pilot basis in one pipe of 2 inches diameter 1 pair of ENEFLOW magnets have been installed maintaining the direction of the flow of water in MTL and HTL of DBL Group and in Multifabs Ltd. Quinn, et. al., (1997) pointed out that when water is passed through a magnetic field, several conditions are important in achieving the desired effects:

• The water path must be perpendicular to the magnetic lines of force. Cutting the lines at 90° is known as the shear force.
• Water should first cut the south magnetic lines and then proceed to break wider and denser alternating reversing polarity lines, until exiting the magnetic chamber through the single north pole flux path.
• Water must be under pressure and moving with the least amount of turbulence possible, just before entering and during its travel through the magnetic fields.

For the present study water samples before entering the magnet and water samples after passing the magnet were collected in the sample bottles and transported to the DBL ETP laboratory to carry out some chemical analyses for example TDS total Hardness and P^H as described by Rajvaidya and Markandey, (1998).

Figure 1: ENEFLOW magnet installed in the water way.

3. RESULTS AND DISCUSSION

Chemical analyses of the sample water collected before and after ENEFLOW magnet of MTL, HTL and Multifabs Ltd. showed that on an average TDS value of water samples before entering and after passing the ENEFLOW magnet is respectively 109.2 mg/l and 96.8 mg/l (As shown in table 1). It implies that the performance of the magnet in terms of TDS removal is about 11 % and hardness of the water samples before entering the magnet on an average is 2.193 mg/l and water samples after passing the magnet on an average is 1.814 mg/l thus the efficiency of the magnet in terms of hardness is about 17% and PH was found to get more neutral. Although no study has been conducted in Bangladesh on magnetic water treatment for scale removal but several studies have been already conducted in different countries. Such a study conducted by Kuivinen, (1975) opined that the National Aeronautics and Space Administration (NASA) tested magnetically treated water, for corrosion rates of steel corrosion coupons. Corrosion rates of 1 to 50 mils/year were obtained using chemical inhibitors, (4 mils/year considered acceptable), with corrosion rates of 0.01 mils/year obtained for the magnetically treated water. Field installations have, however, proven to be very successful in reducing the corrosion rate normally experienced while using chemicals (Quinn, et. al., 1997). On the other hand Reimers, et. al., (1979) reported that use of magnetic field in reducing the formation of boiler scale has been emerging in modern scientific era.

Table 1: Performance of ENEFLOW magnet in the studied industries

Parameter	Before	After	Performance
TDS (mg/l)	109.2	96.8	11.36 % TDS removed
Hardness (mg/l)	2.193	1.814	17.28 % Hardness removed
P^H	6.63	7.01	P^H Neutral

In the studies sample industries the effects of ENEFLOW magnets on the removal of scale was not measure exactly on how much scale has been removed from the boiler. But several months observation of boiler scale formation before and after installation of ENEFLOW magnet confirmed that the period for the formation of scale inside the boiler has been elongated significantly. Some scientific studies showed that the removal of scale build-up on a heat exchange surface has found as high as up to 70% (for example Busch and Busch, 1997). A layer of scale of one mm increases energy consumption by 10% during the heating of water, while a layer of 1 cm increases it already by 50% (Orb, 2007). Several studies showed that removal of scale build-up on a heat exchange surface where even a thin film of 0.8 mm can increase energy efficiency by nearly 10%. The Enecon Corporation, (2012) in their official website mentioned that if the scale thickness is ¾ inches the loss of efficiency is about 90% even if the thickness of the scale is less than ½ inches the loss of efficiency is more than 50% as shown in table 2.

Table 2: Typical loss of efficiency proportional to varying thickness of scale

Scale thickness (in.)	Efficiency loss (%)	Coal wasted per ton (lb.)	Oil wasted per 1000 gal (gal.)	Gas wasted per 1000 (cu. ft.)
1/64	4	80	40	40
1/32	7	140	70	70
1/16	11	220	110	110
1/8	18	360	180	180
3/16	27	540	270	270
1/4	38	760	380	380
3/8	48	960	480	480
1/2	60	1200	600	600
5/8	74	1480	740	740
3/4	90	1800	900	900

(Source: Enecon Corporation, 2012)

4. CONCLUSION

The magnetic treatment of waters in the removal of hardness and TDS was proved to be efficient. The efficiency obtained with this very simple magnetic device can be very much improved if the geometry is better devised. There is a maximum efficiency at an optimal flow of the water to treat. Thorough experiments have to be conducted to check these hypothesis and to assess the possible mechanisms of anti scale action of the magnetic field. Moreover a detailed study should be conducted to investigate the relationship between the removal of hardness from water and removal of scale from boiler.

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