Development of a Conceptual Decision Support System for Drinking Water Treatment Process

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ABSTRACT

Drinking Water Decision Support System (DW-DSS) model is an integration of knowledge based information and programming tool aimed at tackling the overwhelming task of providing water under the condition of poor raw water quality and limited financial capacity. Visual Basic 6.0 was selected for the development due to its event driven ability, its capability of object oriented programming and a user-friendly interface. DW-DSS was developed to help water resource technical personnel and manager in acquiring information on the processes of drinking water treatment plant. Examples of data types, Graphical User Interface (GUI) and simulation results were presented. The simulation result demonstrates the use of DW-DSS model and an algorithm for the process design for drinking water treatment plant in Kachia, Kaduna State. It also estimates coagulation and flocculation detention time, amount of bags of alum needed for treating water of different turbidity, pumping cost of machine and it efficiency with a summary of the treatment process. It was concluded that DW-DSS is a useful tool in drinking water treatment plant

Keywords: Decision Support System, Kachia Water Treatment Plant, Kaduna State, Modeling, Visual Basic

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A number of DSS models used in drinking water treatment has been developed over the years (Luuk and Jeremy, 2006). They are either used to simulate individual treatment process or the whole treatment plant, to enable process engineers and plant operators to optimize the response of the works to changes in raw water quality, plant throughput or process operating conditions (Luuk and Jeremy, 2006). The two main components of DW-DSS are Knowledge based information and Programming Tool.

The process of building knowledge-based system is called knowledge engineering. It has a great deal in common with software engineering and is related to many computer science domain such as artificial intelligence, databases, data mining, expert system, decision support systems and geographic information system (Negnevitsky, 2004). Though, there are varieties of programming languages, Visual Basic 6.0 (VB) programming language which is an event driven programming language has proved effective. It allows programmers to easily create simple graphical user interface application and as well to develop fairly complex application (Mckeown, 2004). In this study, Drinking Water Decision Support System (DW-DSS) was designed to ease appropriate selection of vital procedure for water treatment in order to save cost and time

2 METHODOLOGY

The method adopted in this study is similar to that of Hong (2006), though with a little modification. The choice of the data type for developing DSS for drinking water treatment process was informed by the importance of the data and also as available in literature (Adeogun and Nwude, 2016). As compared to Hong (2006) fewer parameters which can reflect the status of the water were considered. The main focus of this work is the process design of the water treatment plant. As part of the process design, password and username are required in other to enhance security for the software in a user friendly interface.

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The DW-DSS (Figure 2) was developed having 13 forms (1 to 13) which were created using Visual Basic 6.0. Each of the forms except the welcome, summary and appreciation form is for data entry. The Password and Username are entered into form1 and a welcome screen (form 2) is displayed. The water quality parameters are imputed into the parameter input form (form 3) for simulation. On this form (form 3), Nigeria established standard (Table 1) for drinking water quality parameter is displayed. Various treatment processes are being suggested for those inputs. Other responses such as Alum jar test, Aeration, Coagulation and flocculation, Sedimentation, Chemical Demand, Filtration, Disinfection, Pump horsepower and efficiency were entered into respective forms with parameters imputed for simulation (Figure 1). The last form being summary form showed the water parameter capturing the whole treatment process with decision on each parameter to allow for conclusion to be drawn (Figure 2). It has its input parameter from the Parameter Input form.

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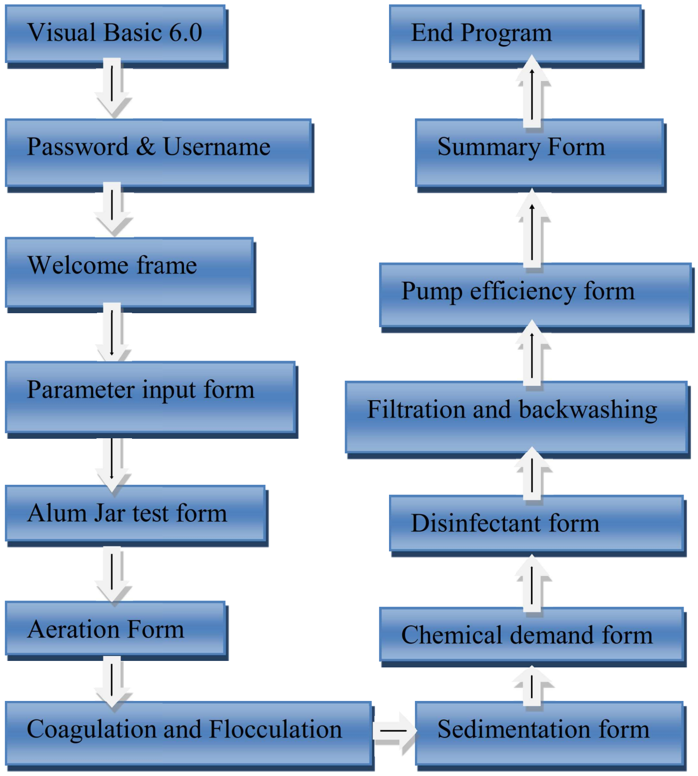

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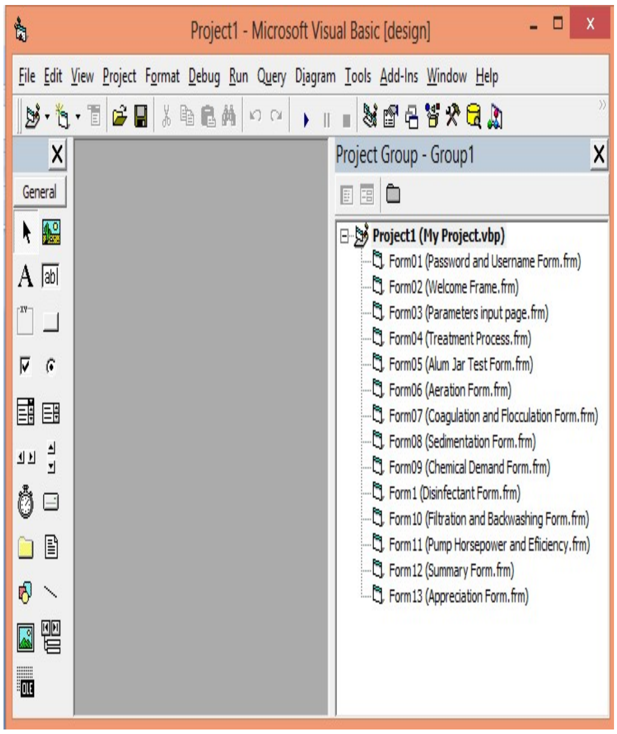

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Using the developed system on the available data of the State Water works Plant having an intake pump capacity of 1246000 liters, alum pump capacity of 7650 liters, plant capacity of 27 million liters per day and using alum concentration of 10%. These specifications were used in the alum jar test calculations to determine (simulate) the part per million of alum concentration, chemical demand , number of bags of alum and the stroke setting of the alum pumping machine. Also, the model was used in the calibration of chemical feeder (dry or solution form). Some 1.608Ib/day was used for dry chemical feed setting, while 15.7708ml/min was used for solution chemical feed setting calibration. Having a water flow rate of the plant as 10 million gallons per day, volume of chemical pumped of 1500 ml and time pumped of 1000 minutes. Furthermore, the model was used to simulate the sedimentation calculations, pump horse power and efficiency estimation and parameter input page respectively. In other to do these, the length (60ft), width (40ft), depth (20ft), the weir length (20ft) and diameter of 15ft for cylindrical sedimentation tank. For the pump horse power, pumping cost and efficiency estimation, the flow rate of the plant (15000gpm), plant head (10ft), pump efficiency (85%) and pumping operation time (500hours) were considered. The physicochemical parameters (such as 5.86NTU, 20TCU and 6.6 for turbidity, colour and pH respectively) of the raw water to be treated are inputted into parameter input form.

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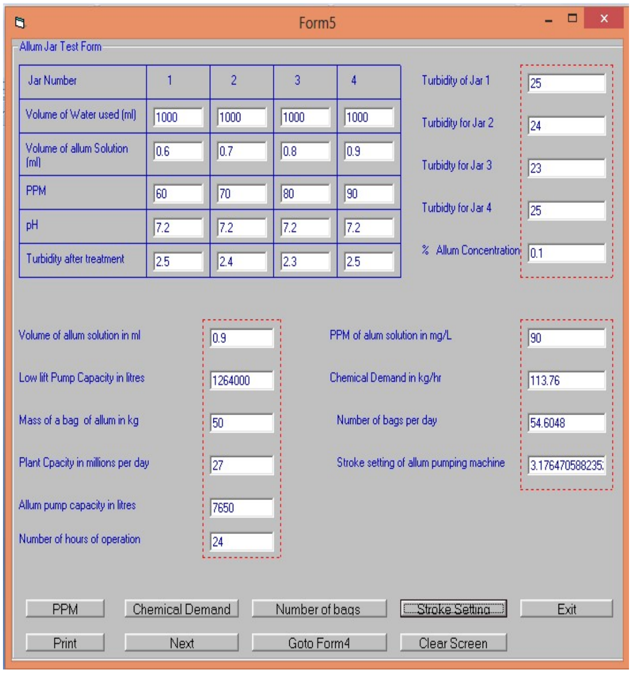

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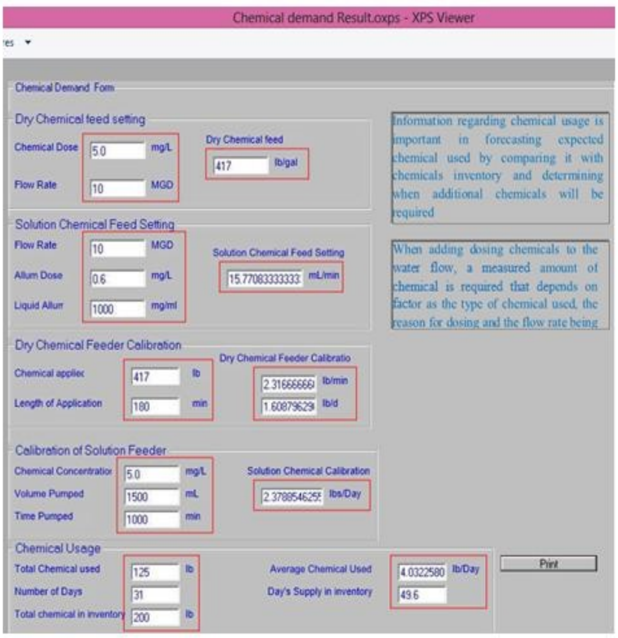

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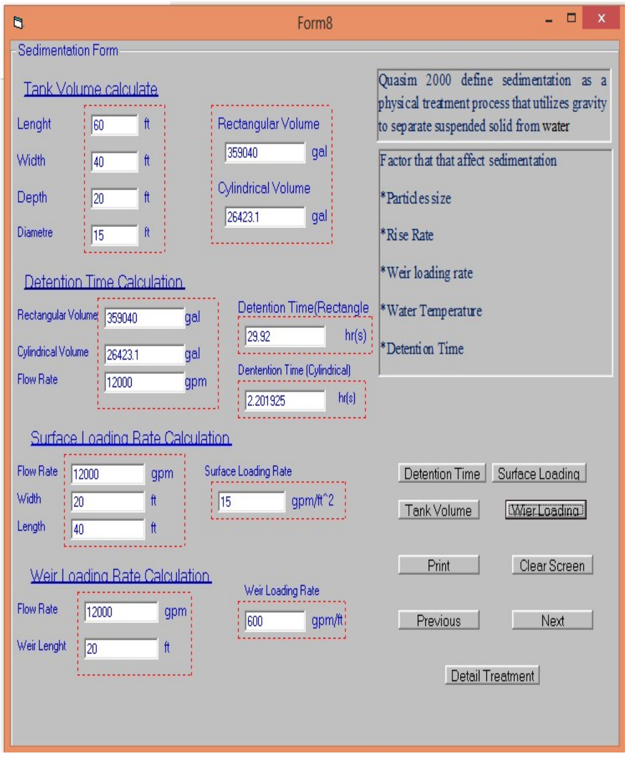

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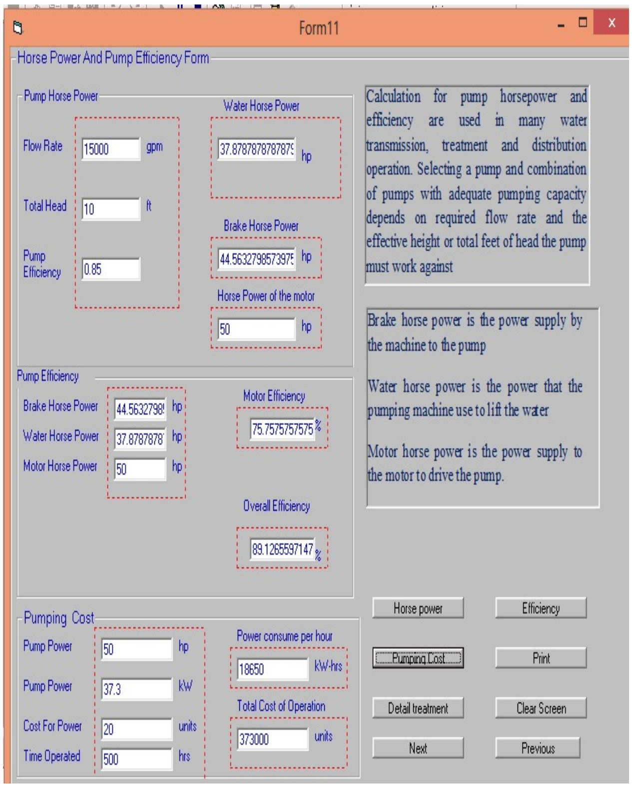

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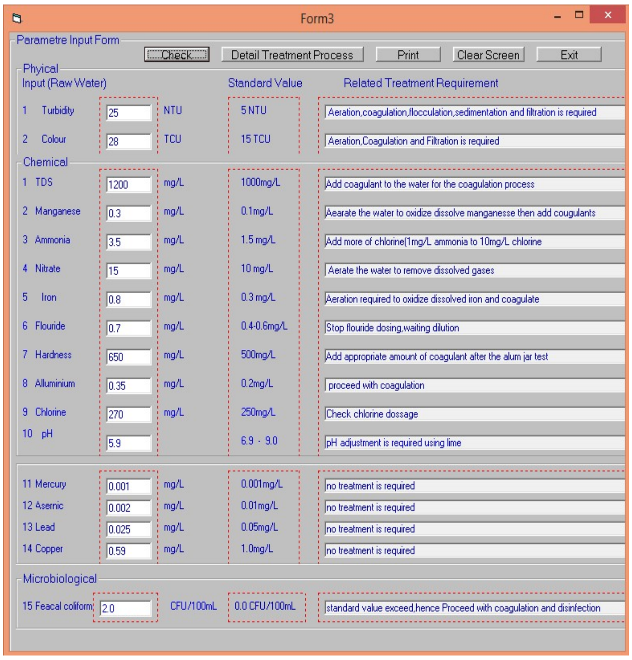

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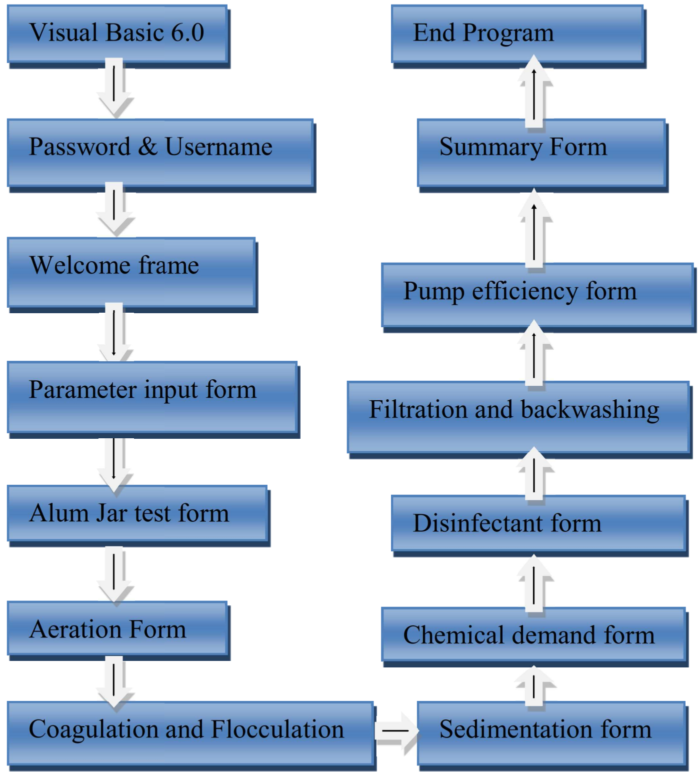

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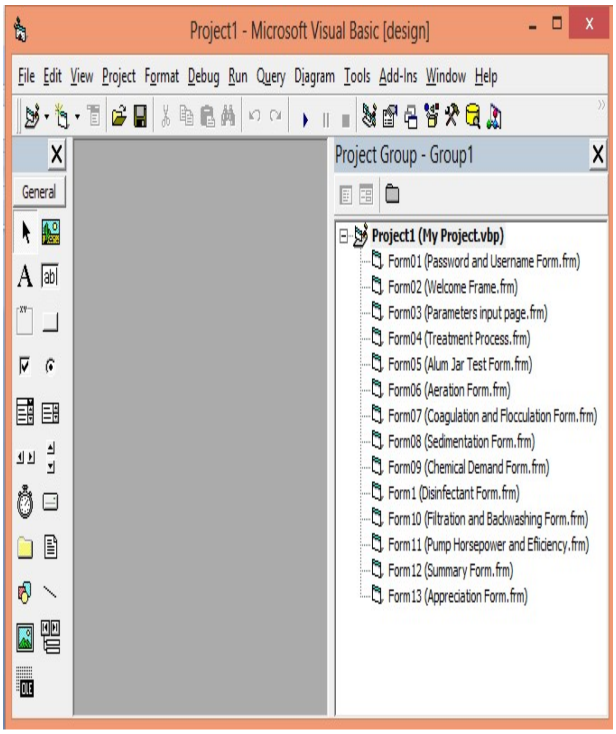

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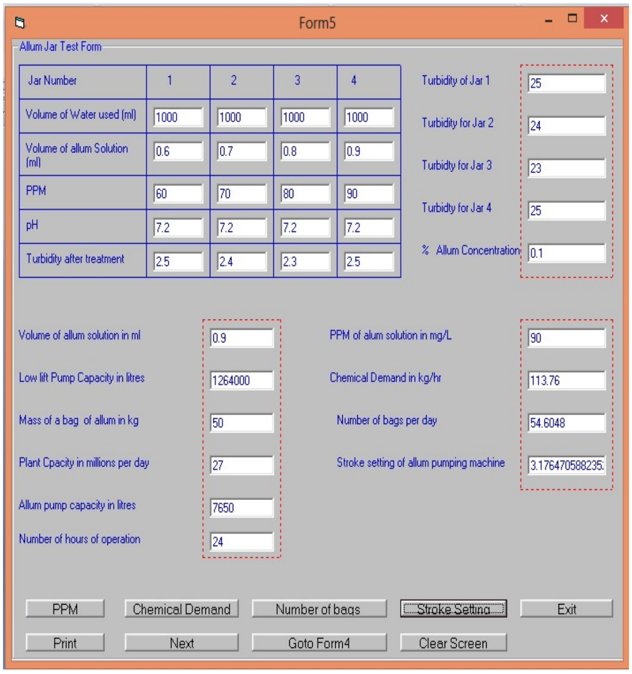

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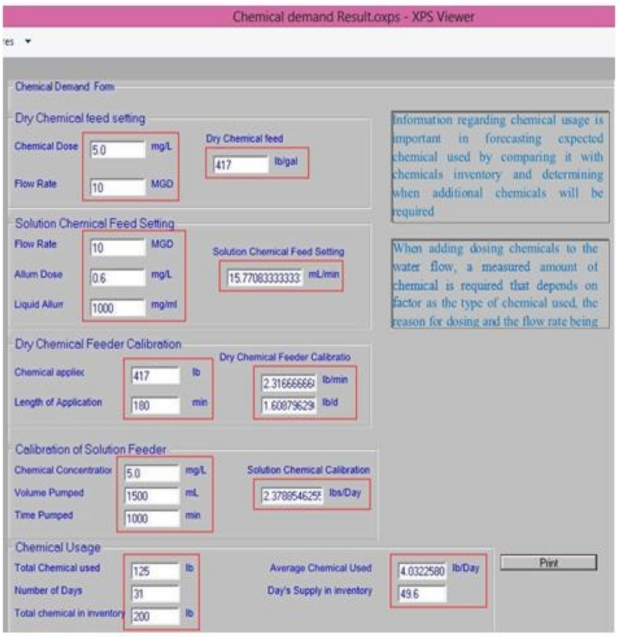

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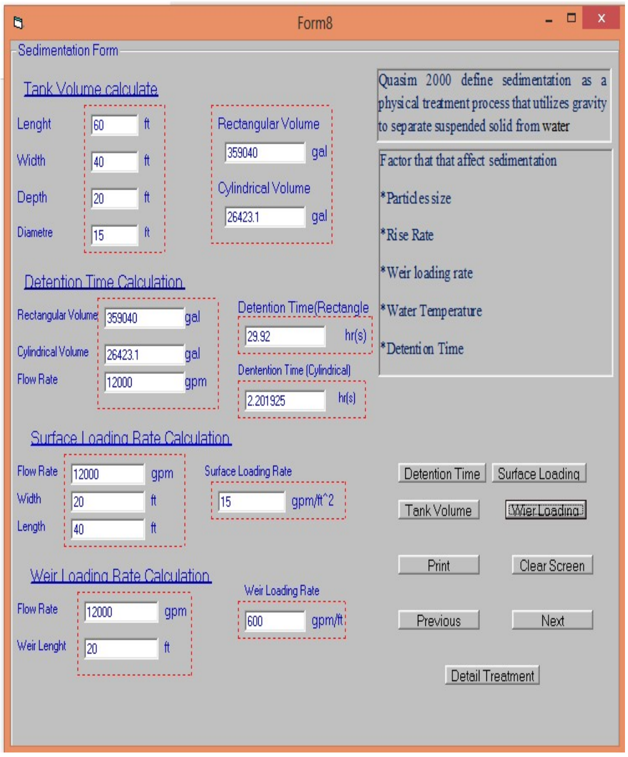

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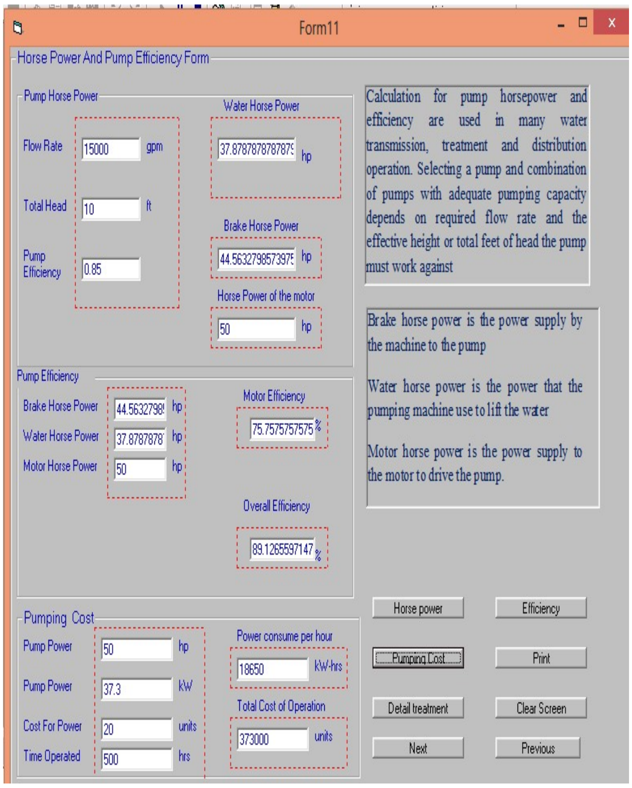

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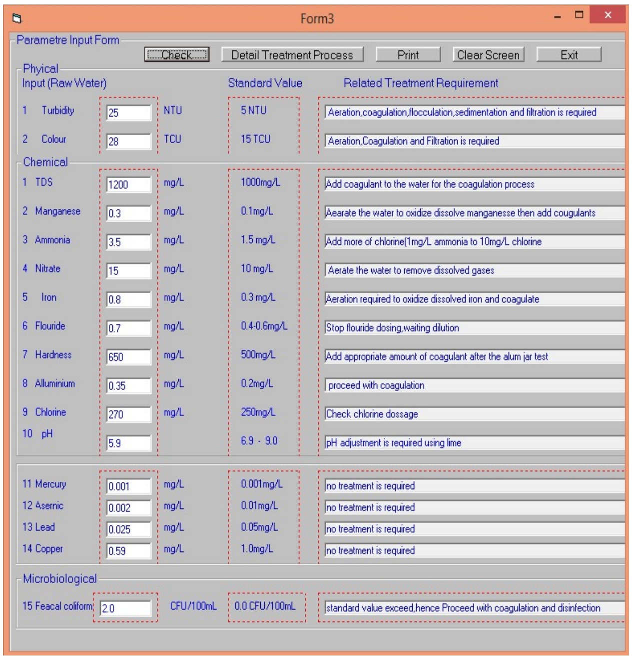

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