Modeling of Water Quality of Qurtabah Neighborhood in Riyadh

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INTRODUCTION

The project aims to simulate residual chlorine decay in a water distribution system consisting of a network of pipes. The area is located in the east part of Riyadh, Qurtabah neighborhood. Data is used from google earth and General Authority for Statistics (GASTAT), And EPANET was used to simulate hydraulic and water quality. To ensure that the water system can meet the demand while maintaining pressure and other requirements.

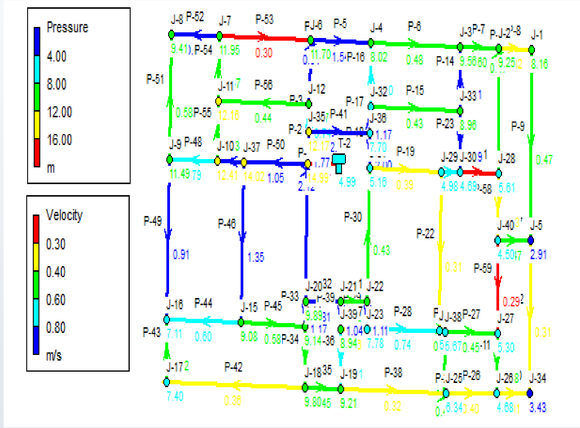

Figure 1. Situation of pressure & velocity in pipes

THEORY

Water quality degradation in distribution networks has a significant impact on human health and public acceptance of tap water. To avoid contamination and microbiological regrowth, residual chlorine should be maintained through network pipes. The ability of EPANET to simulate residual chlorine decay through water networks, taking water-age analyses into account, is investigated in this report, as well as the feasibility of using it as a measuring and controlling tool to estimate and predict chlorine concentration at various water network points.

Also, water systems add chlorine to drinking water to kill or inactivate harmful organisms in a process called “disinfection.” During this process, chlorine also reacts with naturally occurring organic matter that may be present in drinking water. Chlorine disinfection byproducts (DBPs) can form during this chemical reaction.

Chlorinated disinfection agents such as chlorine and monochloramine are strong oxidizing agents introduced into the water in order to destroy pathogenic microbes, oxidize taste/odor- forming compounds, and form a disinfectant residual so water can reach the consumer tap safe from microbial contamination.

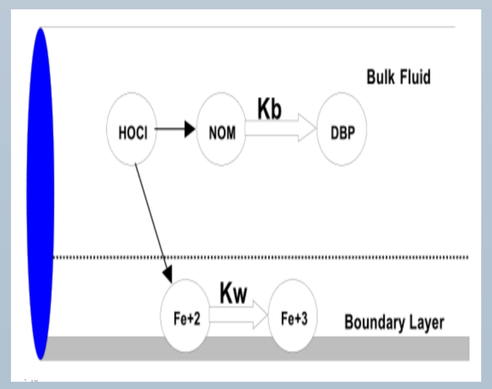

Figure 2. Reaction zones within a pipe.

METHODS AND SIMULATION RESULT

The data has been selected from some basic references (Saudi Building Code, Google Earth program, EPANET User Manual). For example, it got the total area of this project site, the elevations and lengths of all pipes, and the elevations of all tanks and junctions from the Google Earth program.

Table 1. Flow values in pipes Network Links at 12:00 Hrs.

Pipes no.	Flow values L/s
Pipe P-1	130.72
Pipe P-2	55.69
Pipe P-3	13.00
Pipe P-4	7.42
Pipe P-5	7.72
Pipe P-6	8.54
Pipe P-7	10.57
Pipe P-8	4.28
Pipe P-10	-0.60
Pipe P-11	-3.30
Pipe P-13	-3.73
Pipe P-14	4.59
Pipe P-15	-13.64
Pipe P-16	-4.01

Then take this information to the EPANET program, then the project site map can be drawn and distribute the junctions over the whole area in the specific locations and connect these junctions with pipes In addition, some important information can be gleaned from the Saudi Building Code and the EPANET User Manual to aid in the completion of the design and you can use this information in the EPANET program, like choosing the material of all pipes to be galvanized steel so you can know the value of roughness In this project, the Hazen-Williams Formula was chosen when it was needed to find out the head loss.

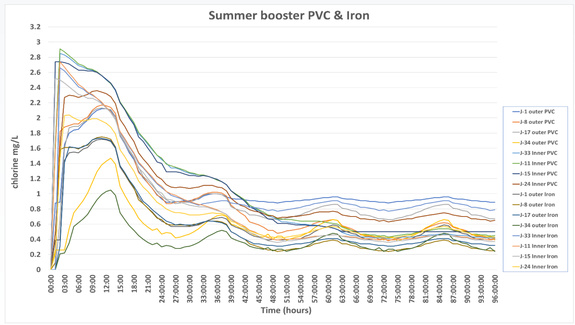

Figure 3. Comparing between PVC & Iron of chlorine booster of the outer and inner nodes.

All the calculations were done in the Excel sheet in detail, but here it will be explained how it was calculated the future population and future demand for all the junctions and which equations were used.

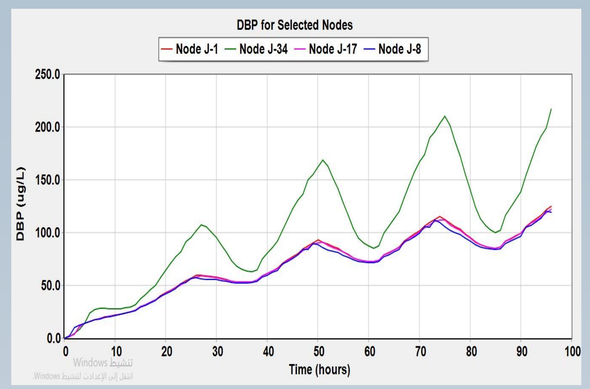

Figure 4.Outer PVC DBP summer formation.

After selecting the pipe diameter and roughness inside the range, it can run the system in the EPANET program. Then it will have to check the pressure and velocity. If there is a condition that is not proper or outside the range, it will go back to the diameter and make any required change Because it is necessary to design with minimal cost, safe, and acceptable quality, it is necessary to produce all the elements inside the range and appropriate, and it can verify the state of other elements and make sure everything inside the range and proper.

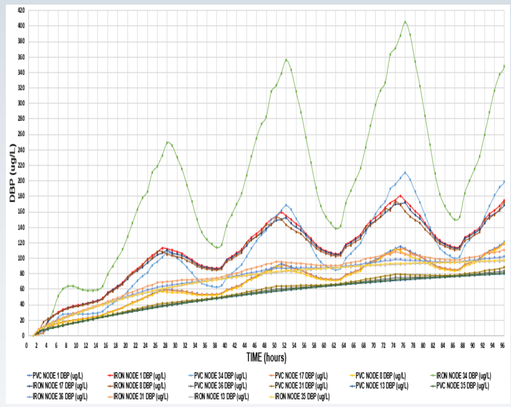

Figure 5.Summer DBP formation in PVC and DI

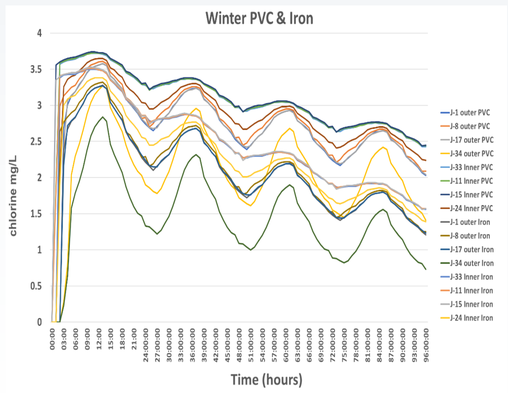

Figure 6. Comparing between PVC & Iron of chlorine decay of the outer and inner nodes .

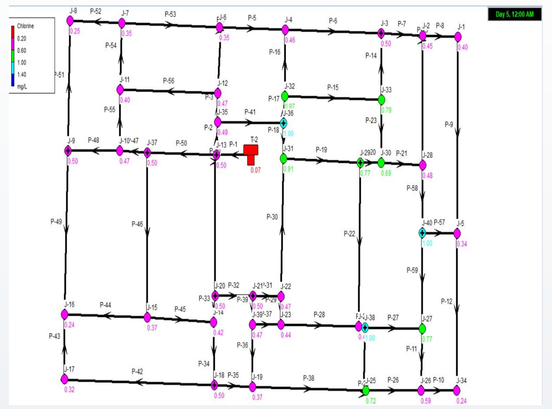

Figure 7.Summer DBP formation in PVC and DI

CONCLUSIONS

- The effects of chlorine less than 0.2 mg/liter on iron and PVC were determined by studying the chlorine trip in both pipes and noting their effects in both summer and winter, as well as near and distant from the tank.
- In addition to fixing the low chlorine by placing a chlorine booster in the junctions to improve chlorine percentage, especially in the summer season, also the outer junctions that are far from the chlorine sources should be addressed
- The most fluctuation occurs at nod 34 of ductile iron.
- The inner nodes in PVC have less fluctuation except node 34. The reason is that the flow is heading toward the node.

FUTURE WORK

- To achieve better outcomes, it may be necessary to investigate the pump's impact on the network.
- Adding a new design with concrete pipes and comparing them to iron and PVC pipes to assess chlorine efficacy.
- It is good to study the effect of aging water and rust.
- In such a design, we recommend using more professional software than EPANET, such as water CAD.
- It’s recommended researching the impact of pH on water and how it is adjusted.

RECOMMENDATIONS

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