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Original Research Article

Effect of Alum on Microbial Load of Well Water from Rural and Urban Areas in Enugu State

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Abstract: Ten well water samples were analyzed for the development of bacterial load using 1%, 5% and 10% concentrations of alum which was added to each 100ml of well water samples to determine the effect of alum on the microbial load of well water from Rural and Urban Areas in Enugu State. After exerting an effect on the well water sample, the supernatants and sediments were analyzed for development of bacteria colonies by viable cell counts. It was observed that the effect of alum on bacterial load increases as the percentage concentration of the of alum increases, however, further increase in the concentration of alum has no effect on the bacterial load, and this can be observed in well water from Ufuma Achara layout, Agbani Nkanu, Ugbo Paul Abakpa, Ohofia Uwani and Amodu Awkunanaw. On the other hand, from1% to 5% concentration of alum has no effect on the supernatant of well water from Amaokwe Achara layout, but however, with increase in concentration of about 10% it began to exert an effect on the bacterial load of both the supernatants and sediments.

Keywords: Alum, effect, microbial load, well water, rural area, urban area, supernatants and sediments**.**

INTRODUCTION

Alum is a specific chemical compound of hydrated aluminum potassium sulfate with the chemical formula K_3 AI $(SO_4)_2.12H_2O$. Alum is commonly used as a coagulant in water treatment system and less frequently in waste treatment system. In water treatment it is used primarily for the removal of tiny particles (called collides, measured as total suspended solids) in the raw water which are too small to settle by gravity in a reasonable length of time (Aguita*et al.*, 2005). Alum is also used to reduce the pH of garden soil. However, in colloid chemistry, alum is used in water purification; it causes impurities to coagulate which are removes as the particulate settle to the bottom of the container. This process is coagulation or flocculation. When alum is added to water, it react with the water and results in positively charged ions. The bivalent ion resulting from alum makes this a very effective primary coagulant (Ahirrao*et al.*, 2001). Flocculation is a process used to remove turbidity, colour and some bacteria from water. In the flash Mix chamber, chemicals are introduced to the water and stirred violently for less than a minute. The floc then settles out in the sedimentation basic. Coagulation removes colloids and suspended solids from the water (Hammer and Hammer, 2005). These particles possessed a negative charge, so the positively charged coagulant chemicals neutralize them during coagulation process. Then, the particles are gathered together by Vander Waals forces, forming floc during flocculation. The coagulation/flocculation process is affected by pH, salts, alkalinity, turbidity, temperature, mixing time, and coagulant chemicals. (Tatsi *et al.*, 2003).

All waters, especially surface water, contain both dissolved and suspended particles. Coagulation and flocculation processes separate the suspended solids

portion from the water. The suspended particles vary in source, composition charge, shape, particle size and density. Correct application of coagulation and flocculation processes and selection of the coagulations depend upon understanding the interaction between these factors. The small particles are stabilized (kept in suspension) by the action of physical forces on the articles themselves (Ahirrao*et al.*, 2001). Most solids suspended in water possess a negative charge and since they have the same type pf surface charge repel each other when they come close together. Therefore, they will remain in suspension rather than clump together and settle out of water. Coagulation and flocculation occur in successive steps to overcome the forces stabilizing the suspended particles, allowing particle growth and collision of floc. If step one is incomplete, the following steps will be unsuccessful (Tatsi *et al.*, 2003). The primary purpose of the coagulation/flocculation process is the removal of turbidity from water. As a result, the maximum allowable level of turbidity in water is 0.5 NTU (Nephelometric turbidity units) a measurement of the turbidity of water (Ahirrao*et al.*, 2001).

MATERIALS AND METHODS

Collection of Well Water Sample

Early morning well water samples were collected from Amechi Awkunanaw, Ituku-ozalla, Ufuma Achara layout, Agbani Nkanu, Amaokwe Achara layout, Obe Nkanu, Federal Housing Abkpa, Ugbo Paul Abakpa, Ohofia Uwani and Amodu Awkunanaw with sterilized bottles with lids which was sealed immediately. The samples were transported to Microbiology laboratory of Enugu State University of Science and Technology Enugu Nigeria immediately after collection for analysis.

Preparation of Alum Sample

This was carried out using a method described by (Pernitsky and Edzwald, 2003). The coagulant used was hydrated potassium aluminates commonly called filter alum.1g, 5g, and 10g lumps of alum were weighed using a weighing balance and was dissolved in 100ml of the well water samples assertively forming 1%, 5% and 10% concentrations. The concentrations of the alum in 100ml of well water in conical flasks were allowed to stand for 40 minutes and then the topmost part called the supernatant was separated from the sediment by decanting. Both the supernatant and the sediments were then analyzed for microbial viability using nutrient agar for viable cell count by pour plate method. In all ten well water samples were analyzed.

Preparation of Supernatants and the Sediments

The supernatants and the sediments were prepared as described by (Hammer and Hammer, 2005). The supernatants and sediments were diluted in 10-foldsusingsterile water in small universal bottles. Dilutions of 10^{-1} - 10^{-3} were therefore made by serial transfer of 1ml each of the sample from the stock to 10^{-1} until10^{-3}. Undiluted water was diluted with a well water sample to give a 10^{-1} dilution and again was mix with one-tenth to give a 10^{-2} and so on. This procedure was repeated for every well water sample, until all the ten well water samples were analyzed.

Pour Plate Preparation

This was carried out according to (Cheesbrough, 2000). 1ml of the dilutions were transferred into a sterile petri-dish using separate sterile syringes and then overlaid with melted sterilized nutrient agar that was cooled to 45^{o}C.The petri-dish was then gently swirled to mix with the liquid agar. The agar was then allowed to solidify. When the agar was set, they were incubated upside down for 18-24hours at 37^{o}C. Thereafter microbial colonies that developed were counted and not more than 300 colonies were counted and viable cells numbers were estimated.

RESULTS

The development of microorganisms in well water from Amechi Awkunanaw treated with different concentrations of alum was determined. The result showed that increase in concentration of alum from 1% to 10% has a successful effect on both the supernatants and sediments of well water samples as shown in Figure 1.

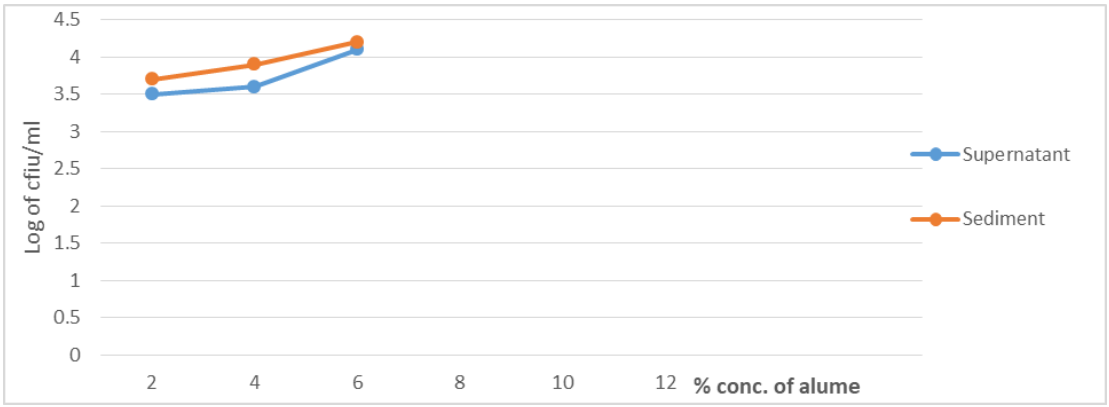

Figure 1: Development of microorganisms in well water from Amechi Awkunanaw treated with different concentrations of alum

The development of microorganisms in well water from Ituku-ozalla treated with different concentrations of alum was determined. The result showed a decrease in the development of able microbes in the sediment in spite of an increase in the concentration of alum from 1% to 5%. However, further increase in the concentration of alum from 5% to 10% shows a positive effect of alum on the bacterial load as shown in Figure 2.

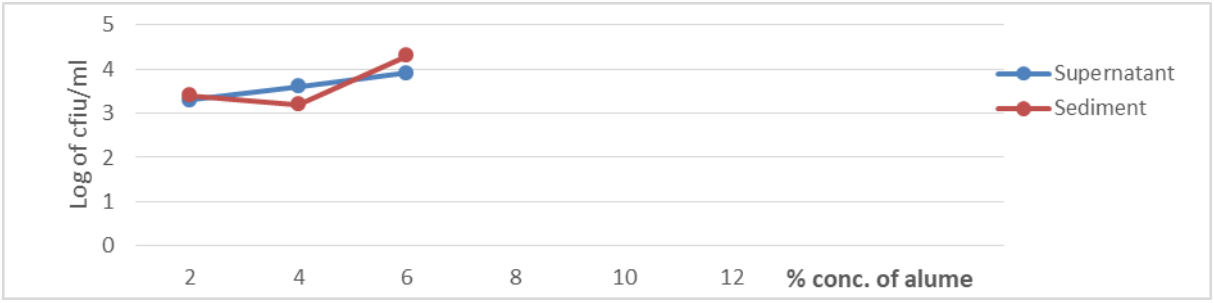

Figure 2: Development of microorganisms in well water from Ituku-ozalla treated with different concentrations of alum

The development of microorganisms in well water from Ufuma (Acharalayout) treated with different concentrations of alum was determined. The result showed that increase in concentration of alum from 1% to 5% has effect on both the supernatants and sediments, of well water samples as shown in Figure 3.

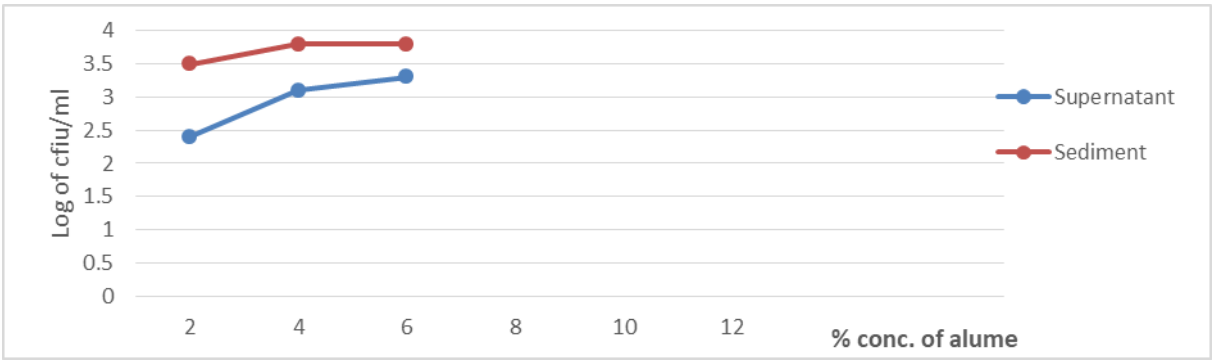

Figure 3: Development of microorganisms in well water from Ufuma (Achara layout) treated with different concentrations of alum

The development of microorganisms in well water from AgbaniNkanu treated with different concentrations of alum was determined. The result showed that increase in concentration of alum from 1% to 5% has effect on both the supernatants and sediments, of well water samples as shown in Figure 4.

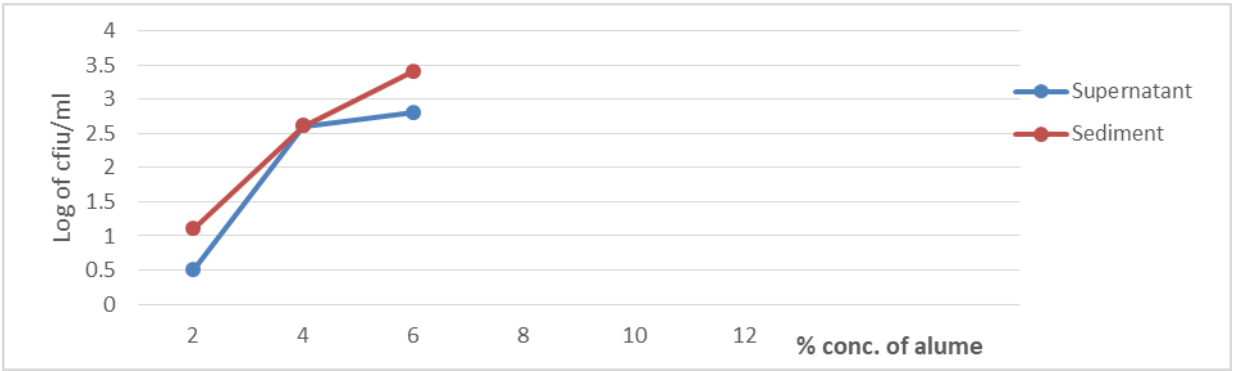

Figure 4: Development of microorganisms in well water from Agbani Nkanu treated with different concentrations of alum

The development of microorganisms in well water from Amaokwe (Achara layout) treated with different concentrations of alum was determined. The result showed that increase in the concentration of alum from1% to 5% has no effect on the supernatants. But

further increase from 5% to 10% has an effect on the bacterial load as shown in Figure 5.

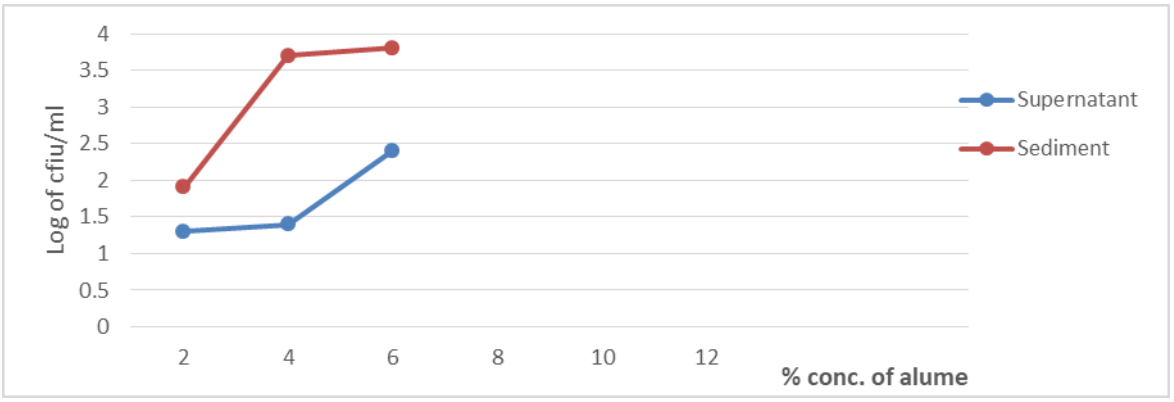

Figure 5: Development of microorganisms in well water from Amaokwe (Achara layout) treated with different concentrations of alum

The development of microorganisms in well water from Obe Nkanu treated with different concentrations of alum was determined. The result showed that increase in the concentration of alum from1% to 5% has no effect on the supernatants. But further increase from 5% to 10% has an effect on the bacterial load as shown in Figure 6.

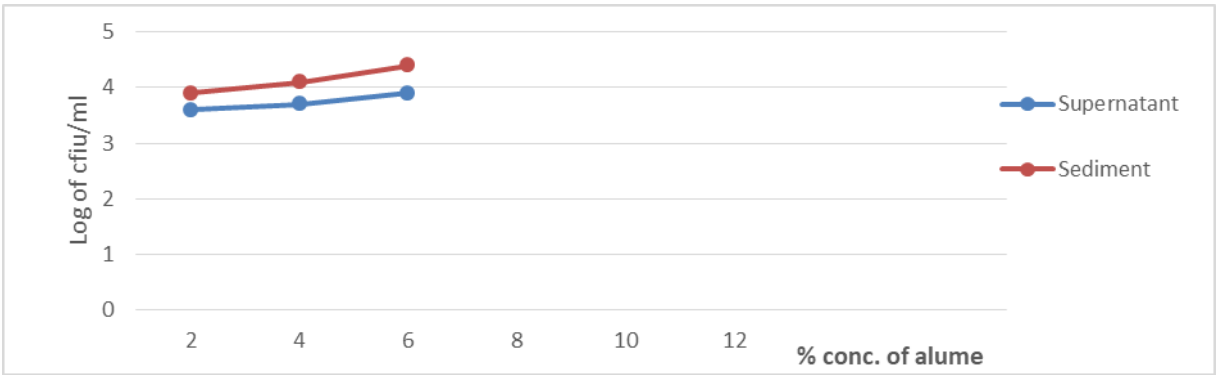

Figure 6: Development of microorganisms in well water from Obe Nkanu treated with different concentrations of alum

The development of microorganisms in well water from Federal Housing Abakpa treated with different concentrations of alum was determined. The result showed a decrease in the development of microbes in the sediment in spite of an increase in the concentration of alum from 1% to 5%. However, further increase in the concentration of alum from 5% to 10% shows a positive effect of alum on the bacterial load as shown in Figure 7.

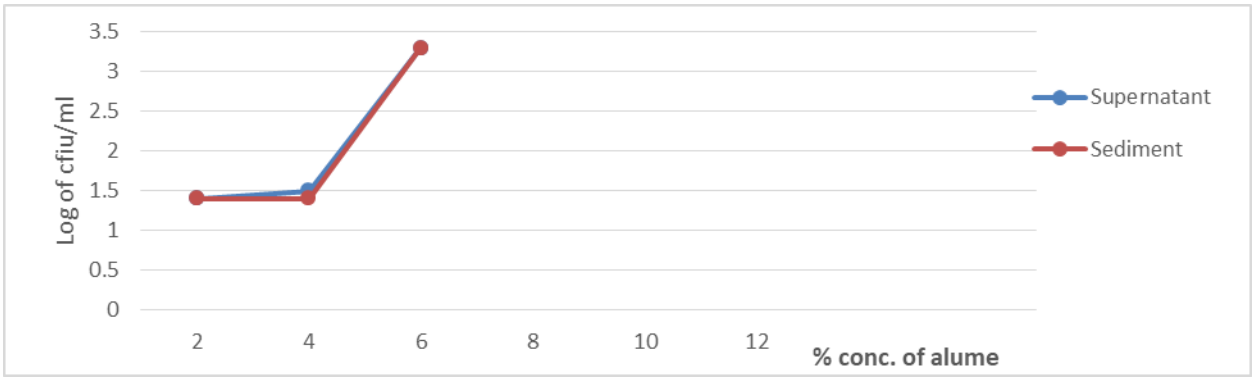

Figure 7: Development of microorganisms in well water from Federal Housing Abakpa treated with different concentrations of alum

The development of microorganisms in well water from Ugbo Paul Abakpa treated with different concentrations of alum was determined. The result showed a decrease in the development of microbes in the supernatant in spite of an increase in the concentration of alum from 1% to 5%. However, further increase in the concentration of alum from 5% to 10% shows a positive effect on both the supernatants and sediments, of well water samples as shown in Figure 8.

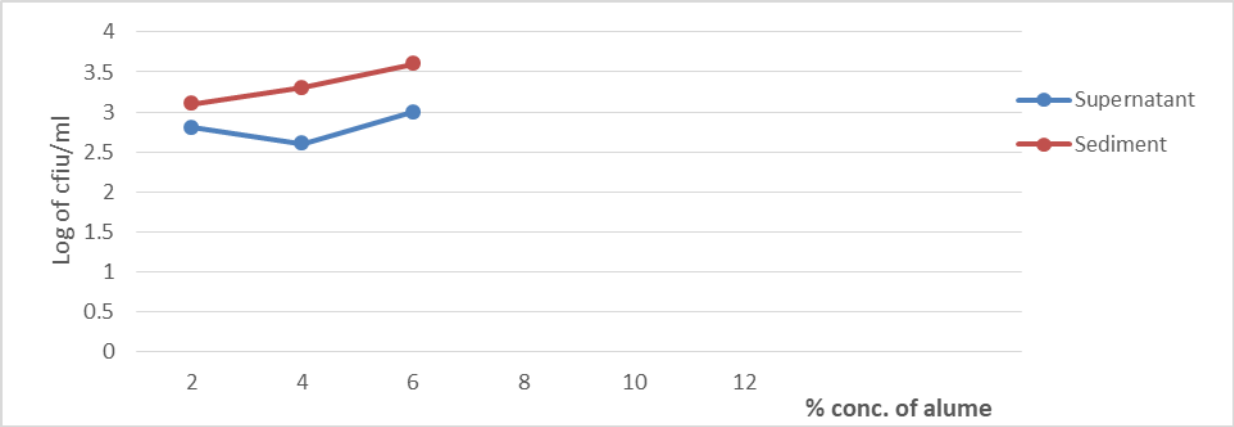

Figure 8: Development of microorganisms in well water from Ugbo Paul Abakpa treated with different concentrations of alum

The development of microorganisms in well water from Ohofia Uwani treated with different concentrations of alum was determined. The result showed that increase in concentration of alum from 1% to 10% has effect on both the supernatants and sediments of well water samples as shown in Figure 9.

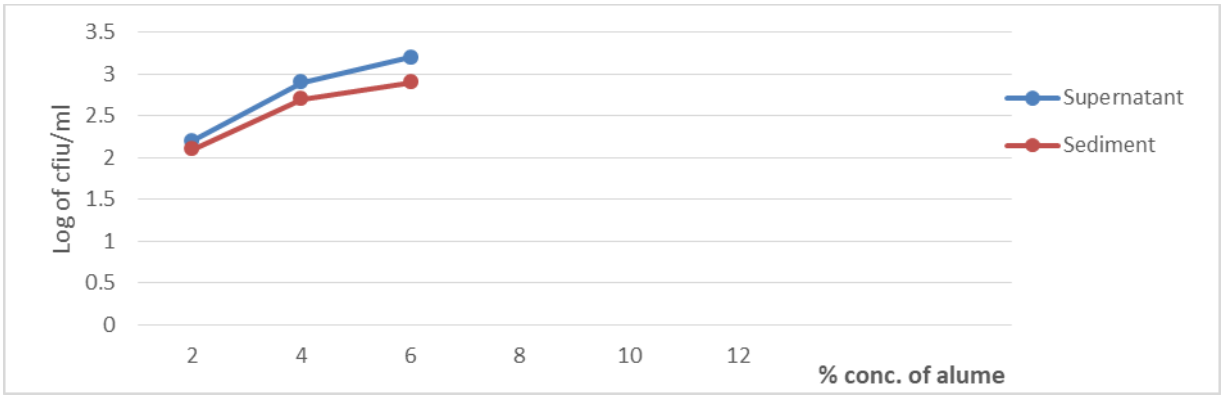

Figure 9: Development of microorganisms in well water from Ohofia Uwani treated with different concentrations of alum

The development of microorganisms in well water from Amodo Awkunanaw treated with different concentrations of alum was determined. The result showed that increase in the concentration of alum from1% to 5% has no effect on the supernatants. But further increase from 5% to 10% has an effect on the bacterial load as shown in Figure 10.

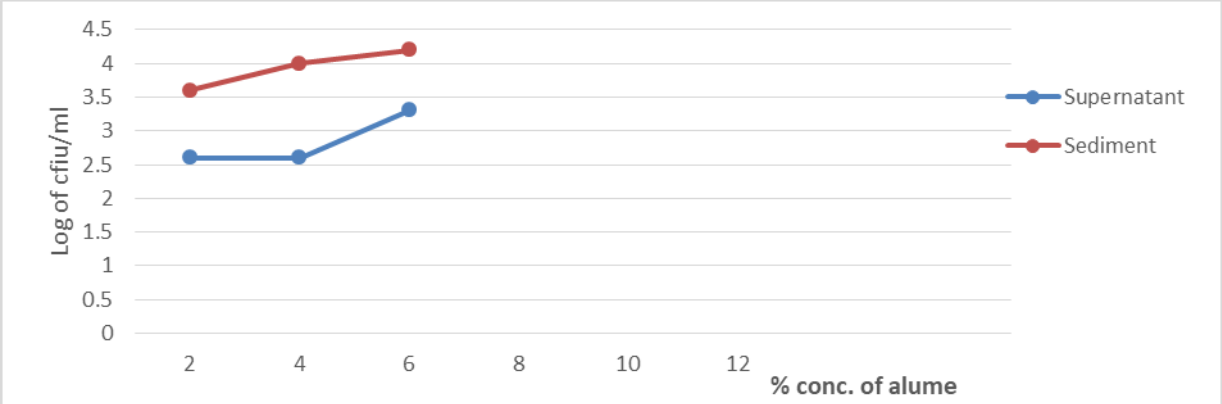

Figure 10: Development of microorganisms in well water from Amodo Awkunanaw treated with different concentrations of alum

DISCUSSIONS

Studies were conducted on ten well water samples for the development of bacterial load using 1%, 5% and 10% concentrations of alum which was added to each 100ml of well water samples to determine the effect of alum on the microbial load of well water from Rural and Urban Areas in Enugu State. The development of microorganisms in well water from Amechi Awkunanaw treated with different concentrations of alum was determined. The result showed that increase in concentration of alum from 1% to 10% has a successful effect on both the supernatants and sediments of well water samples are shown in Figure 1. This agreed with the work of (Tatsi *et al.*, 2003). Experiment was carried out to determine the development of microorganisms in well water from Ituku-ozalla treated with different concentrations of alum. The result showed a decrease in the development of able microbes in the sediment in spite of an increase in the concentration of alum from 1% to 5%. However, further increase in the concentration of alum from 5% to 10% shows a positive effect of alum on the bacterial load are shown in Figure 2. This agreed with the work of (Hammer and Hammer, 2005). The development of microorganisms in well water from Ufuma (Achara layout) treated with different concentrations of alum was determined. The result showed that increase in concentration of alum from 1% to 5% has effect on both the supernatants and sediments, of well water samples as shown in Figure 3. This are in line with the work of (Pernitsky and Edzwald, 2003).The development of microorganisms in well water from Agbani Nkanu treated with different concentrations of alum was determined. The result increase in the concentration of alum from1% to 5% has no effect on the supernatants. But further increase from 5% to 10% has an effect on the bacterial load as shown in Figure 5. This agreed with the work of (Tatsi *et al.*, 2003).

The development of microorganisms in well water from Obe Nkanu treated with different concentrations of alum was determined. The result showed that increase in the concentration of alum from1% to 5% has no effect on the supernatants. But further increase from 5% to 10% has an effect on the bacterial load as shown in Figure 6. This agreed with the work of (Tatsi *et al.*, 2003).The development of microorganisms in well water from Federal Housing Abakpa treated with different concentrations of alum was determined. The result showed a decrease in the development of microbes in the sediment in spite of an increase in the concentration of alum from 1% to 5%. However, further increase in the concentration of alum from 5% to 10% shows a positive effect of alum on the bacterial load as shown in Figure 7.This are in line with the work of (Pernitsky and Edzwald, 2003).The development of microorganisms in well water from Ugbo Paul Abakpa treated with different concentrations of alum was determined. The result showed a decrease in the development of microbes in the supernatant in spite of an increase in the concentration of alum from 1% to 5%. However, further increase in the concentration of alum from 5% to 10% shows a positive effect on both the supernatants and sediments, of well water samples as shown in Figure 8.This are in line with the work of (Pernitsky and Edzwald, 2003).

The development of microorganisms in well water from Ohofia Uwani treated with different concentrations of alum was determined. The result showed that increase in concentration of alum from 1% to 10% has effect on both the supernatants and sediments, of well water samples as shown in Figure 9. This agreed with the work of (Hammer and Hammer, 2005). The development of microorganisms in well water from Amodo Awkunanaw treated with different concentrations of alum was determined. The result showed that increase in the concentration of alum from1% to 5% has no effect on the supernatants. But further increase from 5% to 10% has an effect on the bacterial load as shown in Figure 10. This are in line with the work of (Pernitsky and Edzwald, 2003).

CONCLUSION

This study showed that increase in concentration of alum at 10% exert a successful positive effect on the microbial load of both the supernatants and sediments of well water samples from Rural and

Urban Areas in Enugu State. It could therefore be used for treating well water. However, it is interesting to note that water treated with alum is not recommended for drinking purposes.

Acknowledgement

We humbly express our profound gratitude to the contributions of the staff and students of the Microbiology Laboratory Enugu State University of Science and Technology Enugu Nigeria.

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