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# COMPARISON OF CONVENTIONAL & NON-CONVENTIONAL COAGULANTS AND FLOCCULANTS FOR PRIMARY & SECONDARY TREATMENT OF EFFLUENT FROM VARIOUS INDUSTRIES

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## ABSTRACT

The prevailing most widely used method for coagulation and flocculation are dosages of Alum, copperas, lime, ferric chlorides, but the contaminants removal efficiency from above given Methods are not cost effective. Therefore, the present study focuses on use of different coagulants and flocculants such as conventional and non-conventional to reduce the contaminants from the wastewater. Various parameters (includes pH, COD, TDS, TSS) are to be studied before and after treatment with conventional and non-conventional coagulants respectively and to find out the effect of these coagulants on various effluents. These coagulants are compared with each other and may results in higher removal efficiency of contaminants.

**KEYWORDS**: Coagulants, Flocculants, Conventional, Non-conventional, COD, TDS, TSS.

## INTRODUCTION

Today there is a need to protect our natural resources and sustainable use of our environment. Industrial waste water is water discharged after being used or industrial production processes. Wastewater treatment is closely related to the standard set for the effluent quality. Wastewater treatment process is designed to achieve improvement of the quality of waste water.

Ground water and surface water contain both dissolved and suspended particles. Coagulation and flocculation are used to separate the suspended solids from the water. A suspended solid has negative charge and since they have the same type of surface charge, does not attract each other when they come close together. So that suspended solid will remain in suspension and will not clamp together and settle down of the water unless proper coagulation and flocculation is used.

Coagulation and flocculation process occurs in steps. If coagulation process is not complete, flocculation process will be unsuccessful and flocculation is incomplete, sedimentation will be unsuccessful. Flocculation is a mixing stage; increase the particle size from sub microscopic micro floc to visible suspended particles. Floc size continuous to build with additional collision and interaction with added inorganic poly or organic poly. Coagulant with charges opposite those of the suspended solid are added to the water to neutralize the negative charge on non-settleable solid. Once charge is neutralized the small particles are sticking together and the larger particles which are not visible to necked eyes. Water surrounding the newly formed micro floc should be clear. Some of the particles charge have not neutralized so that more coagulant may need to be added.

Waste water contains pollutant that is present in colloidal form. The colloidal suspension may contain organic material, metal oxides, toxic compounds and turbidity. The purpose of coagulation process is the removal of turbidity from the water. To removing Turbidity from the Wastewater coagulation and flocculation is used. The process removes many bacteria in the water and can be used to remove color from the water.

The most commonly used metal coagulant fall into two categories: based on aluminum and based on iron. The aim of this study is to develop the chemical purification method by evaluating the efficiency of organic poly as coagulant in the treatment of various industrial wastewaters.

## MATERIALS AND METHODS

### Tamarind seed powder

Tamarind seed powder is a substance derived from the seeds of the tamarind tree botanically referred to as

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"Tamarinds Indica". The tamarind tree is an evergreen tree that has its origin in Africa but is very abundant in the Indian region. The tamarind tree is drought resistant hence will do quite well in semi-arid areas that experience minimal precipitation, the tree usually grows to a height of 5 meters but is also known to reach heights of up to 25 meters (80 feet). The seeds are contained in seed or pods that are 3 to 6 inches long with each pod containing approximately 8 to 10 seeds. A full grown tamarind tree usually yields between 175 and 250 kilograms of seed/seed.

***Tamarind seed***

**Moringa Oleifera (drum stick)**

Water extracts of Moringa oleifera seeds are applied to a wastewater treatment sequence comprising coagulation–flocculation–sedimentation. The Moringa coagulant can also be used in combination with other flocculating salts, such as aluminum sulphate. MO also achieved an overall percentage turbidity reduction of 70% for low turbid water (<50NTU), 80% for medium turbid water (50-150NTU) and 95% high turbid water (>150NTU) at 3%w/v and 100mL of MO using 1L of raw water. It was also observed that pH, conductivity, and TDS of the wastewater were not affected by the MO seed powder. Nitrate, chlorine and sulphate were not influenced by the MO except phosphate which recorded a slight increase.


***Moringa oleifera***

**Orange peel Powder**

Orange peels as natural coagulant helps to form a low cost coagulant agent for coagulation process in water treatment plant and act as an important environmental friendly product.

Orange peel powder

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Orange peel principally consists of cellulose, pectin, hemicellulose, lignin, chlorophyll pigments and other low molecular weight hydrocarbons. These components contain various functional groups, such as carboxyl and hydroxyl groups which make the orange peel to be a potential coagulant for removing metal ions from aqueous solutions.

**Alum**

Alum which is available in market is dirty grey solid in the forms of lumps containing about 17%aluminium sulphate. Alum is chemical coagulant which is widely used in waste water treatment plant. Alum react with water in the presence of alkalify, if natural alkalify is not present sufficient lime is added.


***Alum***

**Ferric Chloride**

Ferric Chlorides are effective primary coagulants based on trivalent iron (Fe3+). They are excellent for both drinking and wastewater treatment applications, including phosphorus removal, sludge conditioning. The primary use of ferric chloride is to remove impurities in water and for wastewater treatment. Ferric chloride is the coagulant of choice for many industrial and sanitary wastewater treatment applications, due to its high efficiency, effectiveness in clarification, and utility as a sludge dewatering agent. The chemical leaves slight residual color, and offers very good turbidity removal.`

***Ferric Chloride***

**PAC Coagulant**

Polyaluminum Chloride is well-suited as a primary coagulant in a wide variety of industrial and domestic wastewater treatment plans. Efficient and effective in coagulating particles at a wide range of pH, the chemical leaves no residual color and offers very good turbidity removal. Poly-Aluminum Chloride(PAC) is a kind of innocuous, insipidness and easy dissolve in water with appearance of white or light yellow or yellow Colour lipid from liquid and fine resin solid powder, solid product is easy adsorb damp when exposed in the air.

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***P.A.C***

**Methodology**

Effluents were collected from chemical and textile industry and were preserved till entire practical were performed. Coagulants viz. Tamarind seed powder, Moringa oleifera seed powder, Orange peel powder, Alum, Ferric Chloride, P.A.C were prepared. Effluents were agitated with these coagulants at the dosage of 1gm, 2gm, 4gm, 6gm and 8gm at the speed of 450rpm. Parameters such as pH, COD, TDS and TSS were calculated before and after treatment. A graph of parameters (COD, TDS, TSS, and TOC) against dosage was plotted.

## RESULTS AND DISCUSSION

When the coagulants such as tamarind seed powder, Moringa oleifera seed powder, orange peel powder, alum, ferric chloride and P.A.C. were agitated with the effluent of chemical Industry at 450 rpm, the percentage change in pH of the coagulants obtained is as below:

***Table 1. Percentage change in pH of Chemical Industry when agitated with different coagulants***

| SR NO | DOSAGE | COAGULANTS | | | | | |
|---|---|---|---|---|---|---|---|
| | | TAMARIND SEED POWDER | MORINGA OLEIFERA | ORANGE PEEL POWDER | ALUM | FERRIC CHLORIDE | P.A.C |
| 1 | 1 gm | 11.77% | 9.37% | 2.53% | 1.27% | 1.90% | 5.95% |
| 2 | 2 gm | 13.80% | 12.66% | 15.70% | 1.90% | 3.16% | 6.71% |
| 3 | 4 gm | 18.73% | 15.19% | 32.41% | 4.30% | 4.94% | 7.59% |
| 4 | 6 gm | 18.99% | 17.09% | 34.81% | 5.95% | 5.70% | 8.73% |
| 5 | 8 gm | 19.87% | 17.72% | 36.71% | 8.86% | 8.61% | 11.01% |

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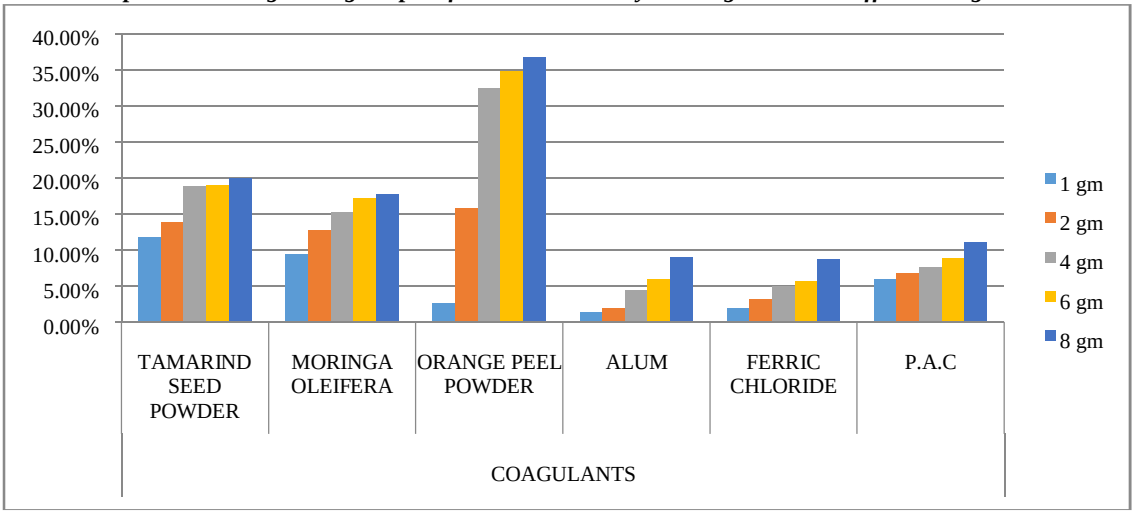
***Graph 1. Percentage change in pH of Chemical Industry when agitated with different coagulants***




When the coagulants such as tamarind seed powder, moringa oleifera seed powder, orange peel powder, alum, ferric chloride and P.A.C. were agitated with the effluent of textile Industry at 450 rpm, the percentage change in pH of the coagulants obtained is as below:

***Table 2. Percentage change in pH of Textile Industry when agitated with different coagulants***

| SR NO | DOSAGE | COAGULANTS | | | | | |
|---|---|---|---|---|---|---|---|
| | | TAMARIND SEED POWDER | MORINGA OLEIFERA | ORANGE PEEL POWDER | ALUM | FERRIC CHLORIDE | P.A.C |
| 1 | 1 gm | 12.88% | 12.27% | 0.37% | 1.84% | 3.07% | 1.84% |
| 2 | 2 gm | 23.93% | 13.74% | 10.31% | 3.31% | 5.40% | 2.94% |
| 3 | 4 gm | 28.96% | 15.46% | 15.34% | 4.79% | 7.48% | 4.54% |
| 4 | 6 gm | 29.45% | 19.63% | 20.98% | 9.20% | 11.41% | 7.48% |
| 5 | 8 gm | 29.94% | 22.09% | 23.44% | 11.66% | 13.62% | 10.06% |

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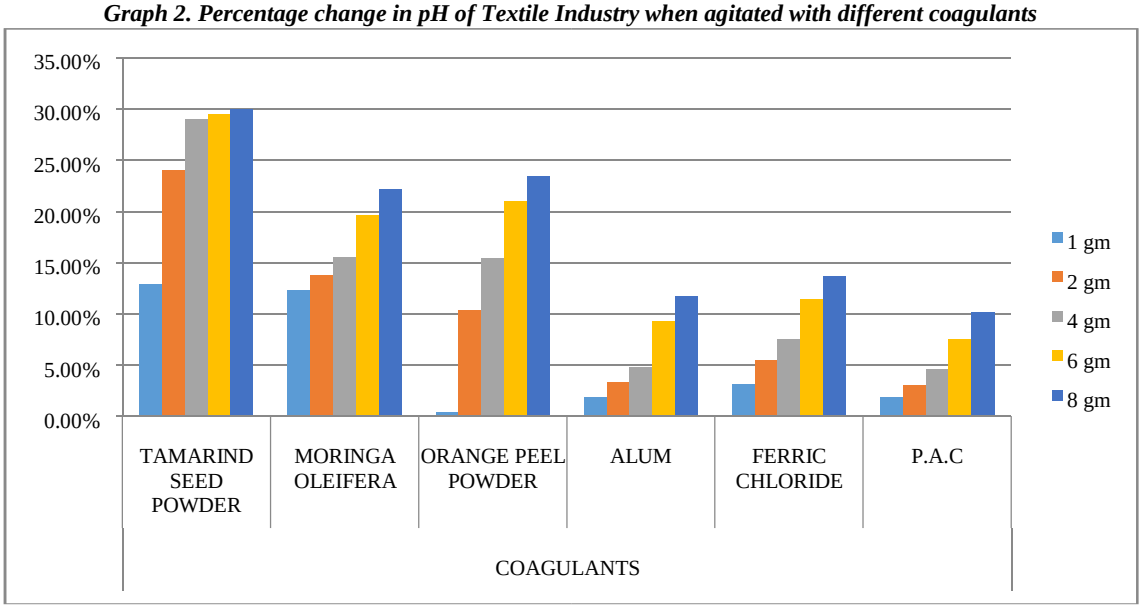
***Graph 2. Percentage change in pH of Textile Industry when agitated with different coagulants***




When the coagulants such as tamarind seed powder, moringa oleifera seed powder, orange peel powder, alum, ferric chloride and P.A.C. were agitated with the effluent of chemical Industry at 450 rpm, the percentage change in COD of the coagulants obtained is as below:

***Table 3. Percentage change in COD of Chemical Industry when agitated with different coagulants***

| SR NO | DOSAGE | COAGULANTS | | | | | |
|---|---|---|---|---|---|---|---|
| | | TAMARIND SEED POWDER | MORINGA OLEIFERA | ORANGE PEEL POWDER | ALUM | FERRIC CHLORIDE | P.A.C |
| 1 | 1 gm | 5.60% | 8.00% | 4.16% | 5.60% | 3.20% | 4.80% |
| 2 | 2 gm | 15.20% | 13.60% | 10.56% | 11.60% | 8.00% | 12.00% |
| 3 | 4 gm | 29.60% | 20.80% | 15.52% | 23.20% | 20.00% | 26.80% |
| 4 | 6 gm | 38.00% | 36.00% | 25.16% | 35.00% | 36.80% | 28.00% |
| 5 | 8 gm | 39.20% | 40.00% | 29.92% | 31.20% | 32.00% | 32.72% |

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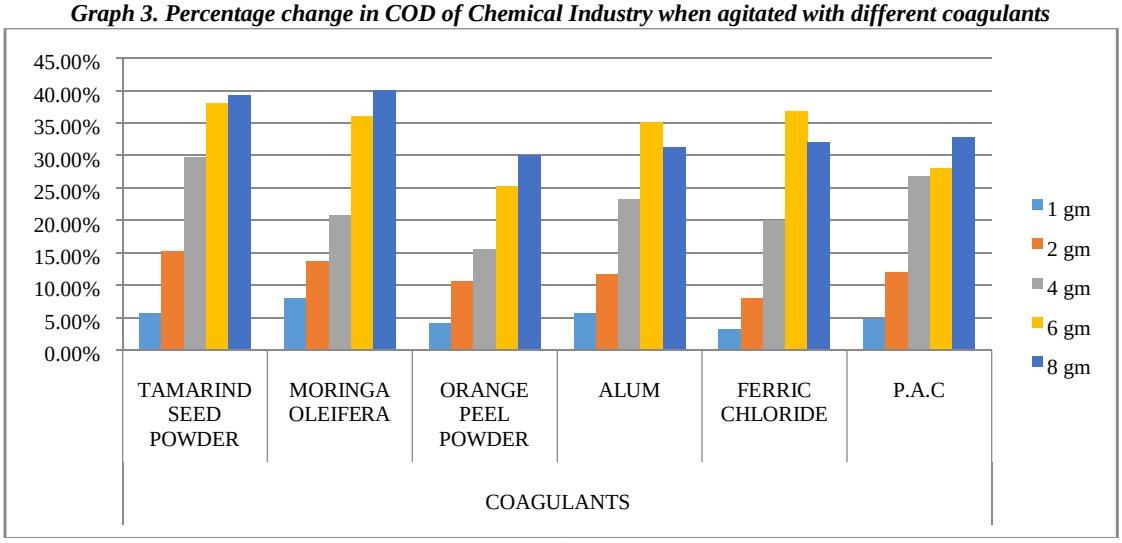
***Graph 3. Percentage change in COD of Chemical Industry when agitated with different coagulants***




When the coagulants such as tamarind seed powder, moringa oleifera seed powder, orange peel powder, alum, ferric chloride and P.A.C. were agitated with the effluent of textile Industry at 450 rpm, the percentage change in COD of the coagulants obtained is as below:

***Table 4. Percentage change in COD of Textile Industry when agitated with different coagulants***

| SR NO | DOSAGE | COAGULANTS | | | | | |
|---|---|---|---|---|---|---|---|
| | | TAMARIND SEED POWDER | MORINGA OLEIFERA | ORANGE PEEL POWDER | ALUM | FERRIC CHLORIDE | P.A.C |
| 1 | 1 gm | 6.25% | 7.50% | 9.38% | 6.25% | 5.00% | 3.13% |
| 2 | 2 gm | 7.50% | 17.50% | 19.38% | 13.75% | 10.63% | 7.50% |
| 3 | 4 gm | 28.13% | 36.25% | 30.00% | 23.75% | 22.19% | 14.38% |
| 4 | 6 gm | 29.00% | 27.50% | 31.88% | 30.00% | 25.00% | 18.75% |
| 5 | 8 gm | 27.56% | 30.00% | 27.94% | 25.31% | 23.19% | 17.56% |

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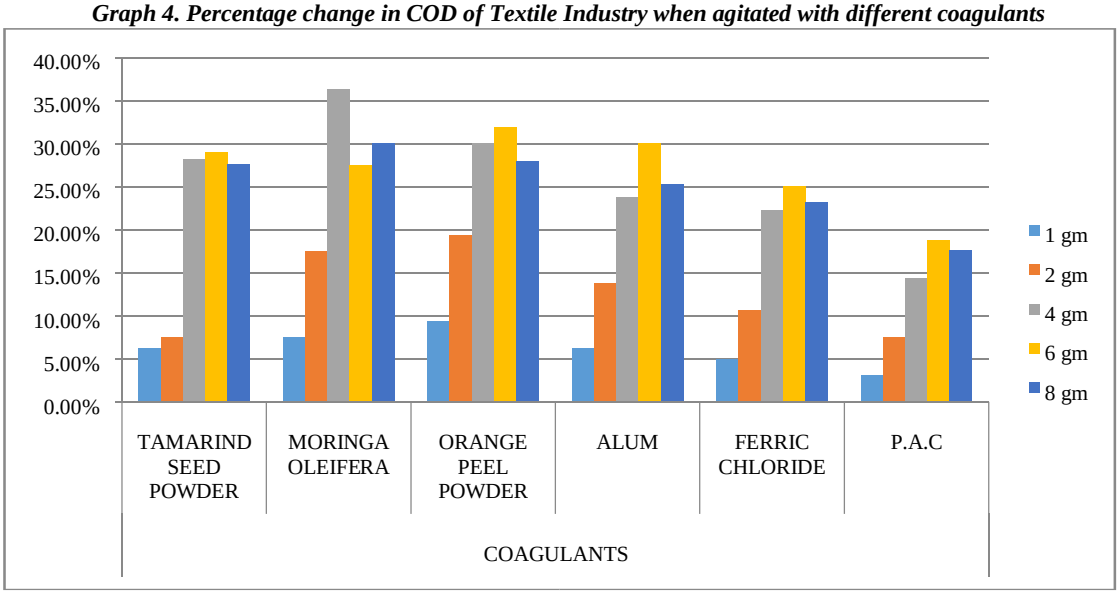
***Graph 4. Percentage change in COD of Textile Industry when agitated with different coagulants***




When the coagulants such as tamarind seed powder, moringa oleifera seed powder, orange peel powder, alum, ferric chloride and P.A.C. were agitated with the effluent of Chemical Industry at 450 rpm, the percentage change in TDS of the coagulants obtained is as below:

***Table 5. Percentage change in TDS of Chemical Industry when agitated with different coagulants***

| SR NO | DOSAGE | COAGULANTS | | | | | |
|---|---|---|---|---|---|---|---|
| | | TAMARIND SEED POWDER | MORINGA OLEIFERA | ORANGE PEEL POWDER | ALUM | FERRIC CHLORIDE | P.A.C |
| 1 | 1 gm | 1.33% | 2.67% | 2.00% | 2.67% | 4.00% | 4.67% |
| 2 | 2 gm | 3.33% | 1.33% | 5.13% | 4.00% | 4.13% | 6.67% |
| 3 | 4 gm | 5.20% | 2.53% | 7.53% | 8.00% | 9.27% | 8.80% |
| 4 | 6 gm | 7.27% | 10.80% | 9.07% | 12.80% | 20.60% | 20.00% |
| 5 | 8 gm | 15.27% | 11.87% | 11.67% | 13.33% | 15.27% | 13.47% |

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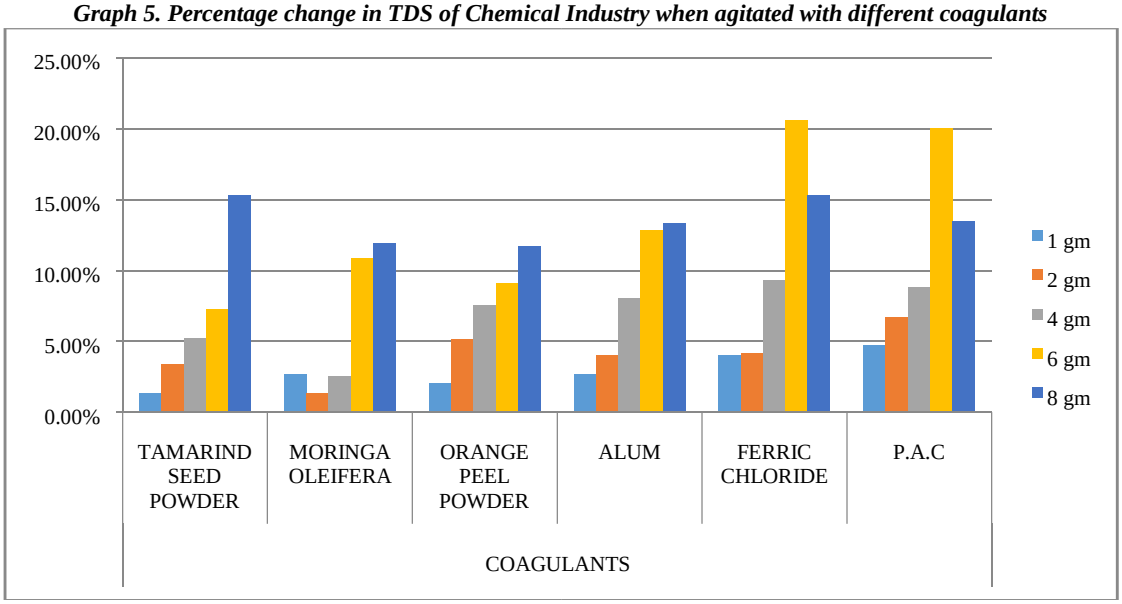
***Graph 5. Percentage change in TDS of Chemical Industry when agitated with different coagulants***




When the coagulants such as tamarind seed powder, moringa oleifera seed powder, orange peel powder, alum, ferric chloride and P.A.C. were agitated with the effluent of textile Industry at 450 rpm, the percentage change in TDS of the coagulants obtained is as below:

***Table 6. Percentage change in TDS of Textile Industry when agitated with different coagulants***

| SR NO | DOSAGE | COAGULANTS | | | | | |
|---|---|---|---|---|---|---|---|
| | | TAMARIND SEED POWDER | MORINGA OLEIFERA | ORANGE PEEL POWDER | ALUM | FERRIC CHLORIDE | P.A.C |
| 1 | 1 gm | 2.92% | 15.69% | 15.38% | 16.62% | 18.77% | 7.69% |
| 2 | 2 gm | 3.23% | 13.85% | 18.15% | 17.23% | 20.77% | 9.23% |
| 3 | 4 gm | 5.23% | 26.00% | 31.54% | 19.38% | 25.85% | 21.54% |
| 4 | 6 gm | 3.08% | 23.08% | 28.62% | 21.54% | 27.08% | 15.69% |
| 5 | 8 gm | 2.77% | 19.54% | 26.92% | 20.00% | 26.31% | 15.08% |

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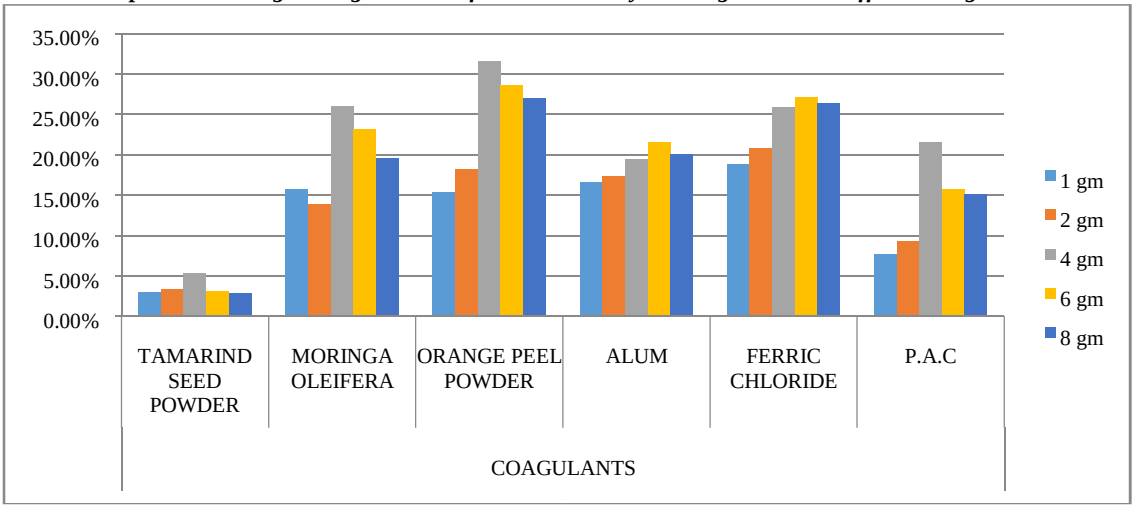
***Graph 6. Percentage change in TDS of Textile Industry when agitated with different coagulants***




When the coagulants such as tamarind seed powder, moringa oleifera seed powder, orange peel powder, alum, ferric chloride and P.A.C. were agitated with the effluent of Chemical Industry at 450 rpm, the percentage change in TDS of the coagulants obtained is as below:

***Table 7. Percentage change in TSS of Chemical Industry when agitated with different coagulants***

| SR NO | DOSAGE | COAGULANTS | | | | | |
|---|---|---|---|---|---|---|---|
| | | TAMARIND SEED POWDER | MORINGA OLEIFERA | ORANGE PEEL POWDER | ALUM | FERRIC CHLORIDE | P.A.C |
| 1 | 1 gm | 15.69% | 1.96% | 1.96% | 9.31% | 14.22% | 5.88% |
| 2 | 2 gm | 23.53% | 9.80% | 3.92% | 17.65% | 19.61% | 8.82% |
| 3 | 4 gm | 33.33% | 13.73% | 17.65% | 31.86% | 27.45% | 15.20% |
| 4 | 6 gm | 37.25% | 25.49% | 30.39% | 26.47% | 36.27% | 16.67% |
| 5 | 8 gm | 45.10% | 36.27% | 39.22% | 20.59% | 28.92% | 12.75% |

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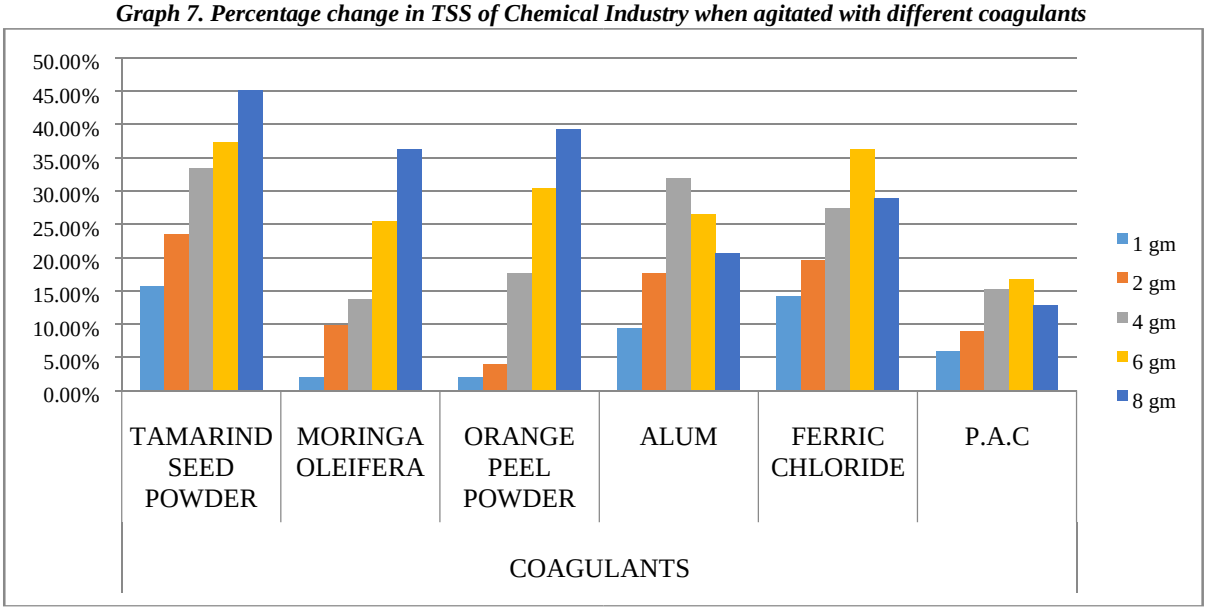
***Graph 7. Percentage change in TSS of Chemical Industry when agitated with different coagulants***




When the coagulants such as tamarind seed powder, moringa oleifera seed powder, orange peel powder, alum, ferric chloride and P.A.C. were agitated with the effluent of textile Industry at 450 rpm, the percentage change in TSS of the coagulants obtained is as below:

***Table 8. Percentage change in TSS of Textile Industry when agitated with different coagulants***

| SR NO | DOSAGE | COAGULANTS | | | | | |
|---|---|---|---|---|---|---|---|
| | | TAMARIND SEED POWDER | MORINGA OLEIFERA | ORANGE PEEL POWDER | ALUM | FERRIC CHLORIDE | P.A.C |
| 1 | 1 gm | 30.00% | 8.50% | 2.00% | 10.00% | 6.00% | 5.00% |
| 2 | 2 gm | 37.00% | 16.00% | 6.00% | 21.00% | 16.00% | 8.50% |
| 3 | 4 gm | 45.00% | 35.00% | 38.00% | 30.00% | 25.00% | 12.50% |
| 4 | 6 gm | 35.00% | 23.00% | 36.00% | 50.00% | 32.50% | 5.00% |
| 5 | 8 gm | 37.00% | 12.50% | 33.00% | 40.00% | 27.50% | 3.00% |

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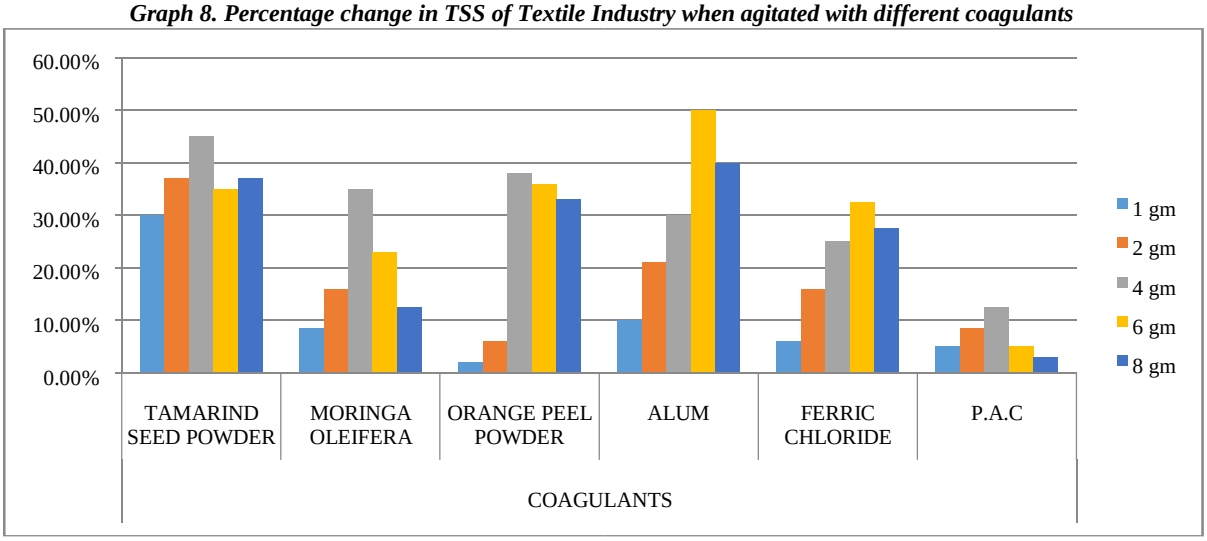
*Graph 8. Percentage change in TSS of Textile Industry when agitated with different coagulants*




## CONCLUSION

Based on the readings obtained during the practical and the observation tables prepared on its basis, it can be concluded that with the increase in the dosage the COD, TDS, TSS, reduction increases and the maximum reduction of COD, TDS, TSS is obtained at a dosage value of 8gm/500ml for natural coagulants and 6gm/500ml for chemical coagulants for chemical industry. With the further increase in dosage, COD, TDS, TSS reduction decreases which can be easily visualized from the graph also.

In case of textile industry, it can be concluded that with the increase in the dosage the COD, TDS, TSS, reduction increases and the maximum reduction of COD, TDS, TSS is obtained at a dosage value of 4gm/500ml for natural coagulants and 6gm/500ml for chemical coagulants. With the further increase in dosage, COD, TDS, TSS reduction decreases which can be easily visualized from the graph also.

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