Optimization Of Nanoparticle Compozil System To Increase The Retention And Drainage


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ABSTRACT

Nanoparticles are cast-off in the industry as retention & drainage utilities, frequently in aggregation with cationic starch. The industrial trial concentrated on optimization of Nano silica dose on paper industry in rejoinder with respect to parameters like drainage values, first pass retention; first pass ash retention, cationic charge demand of the whole system, and optical properties like opacity& brightness and strength properties. The interpretations showed that the Nano silica increases the first pass retention, first pass ash retention, drainage and have an analogous effect on optical and strength properties. This is because of the introduction of nanoparticles into a starch transfigures the fiber mat into a porous form that is approachable to retention and drainage.

Introduction

Nanoparticles use in the papermaking process has a long history. Papermaking technology is a leading technology in terms of the amount of nano particles used. Nano silica and related products were employed each year to promote dewatering and fine-particle retention on thousands of paper machines, yet there are many uses of nanoparticles in this area that are unknown to papermaker. Recently among nanoparticles, anionic colloidal silica has been used the most. The laboratory-made nanoparticles like organically modified cationic silica nanoparticles and other nano-structured silica's are also used in papermaking applications. The effect of nanoparticles on drainage and retention in the presence of cationic polyelectrolyte like starch has been studied frequently, but the mechanism of contribution of nanoparticles on drainage and retention is not clearly proposed till yet. It is proposed that colloidal silica is very small in size so that it can easily enter to the amorphous structure of the cationic as a result of which it neutralizes the starch cationic charge, thereby compressing the electrical double layer, which requirement for retention. Aloi proposed that a proper ionic concentration from anionic micro particles to achieve near-neutrality of the electrical double layers in the system is a prerequisite for flocculation or coagulation thus enhancing the retention. Solberg and Walberg anticipated that the retrenchment is based on substituting weak hydrogen bonds with strong ionic bonds, thus crumpling the flocs under their own weight, a reason for enhanced dewatering. To explain the role of interfaces between micro particles and polyelectrolyte molecules on retention and drainage in pulp processing, Hubble (2005) suggested a model. The model is based on a spanning mechanism through cationic polyelectrolytes, but the presence of micro particles or nanoparticles in the system converts the system to a new type of association, which involves impediment between the polyelectrolyte and the nanoparticle. The combined additives then function simultaneously both as a drainage agent and also as a retention agent. The relation between nanoparticles' impact on drainage and retention with zeta potential has been studied previously. It has been projected that nanoparticles are effective in retention or drainage if the whole system operates in a mildly positive charge zone (Hubble 2005b). This premise has also been examined in the labs using Nano silica with cationic starch by checking the changes in zeta potential of the suspension.

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Litreature

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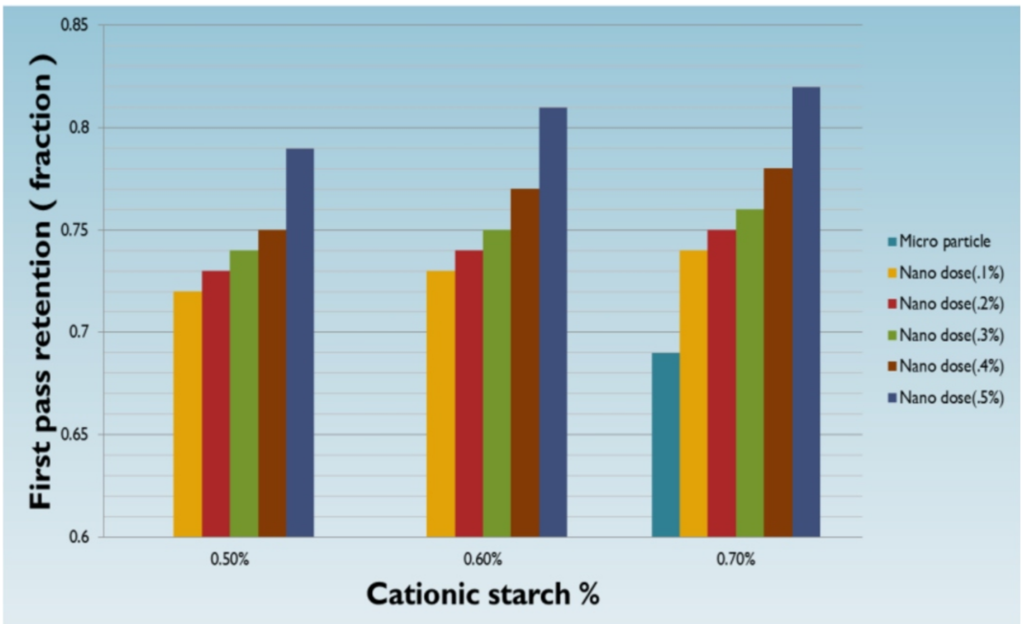
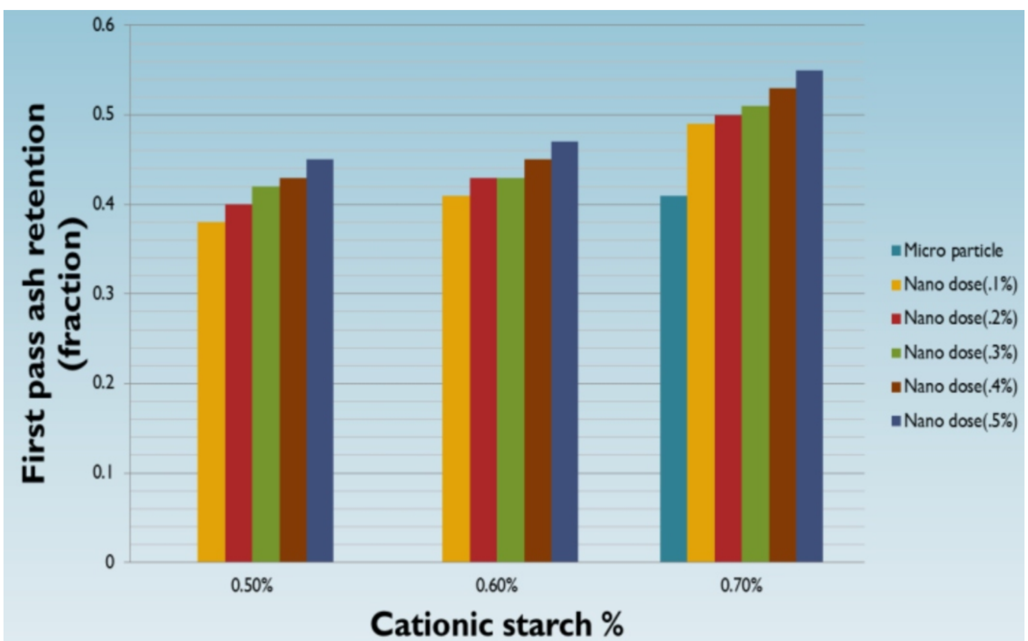
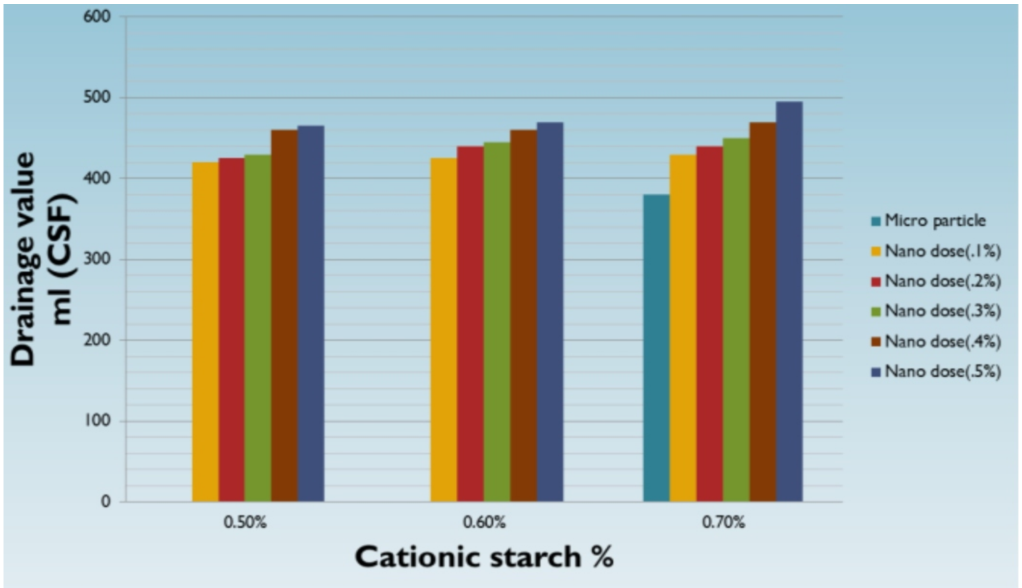


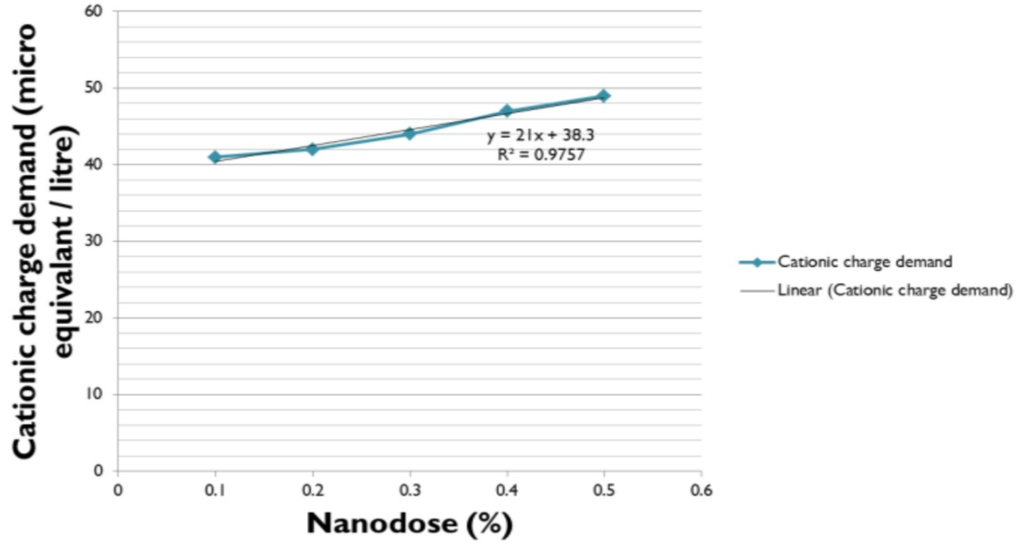
(Effect of different nanoparticle dose on First Pass Retention (FPR) with different cationic starch levels)



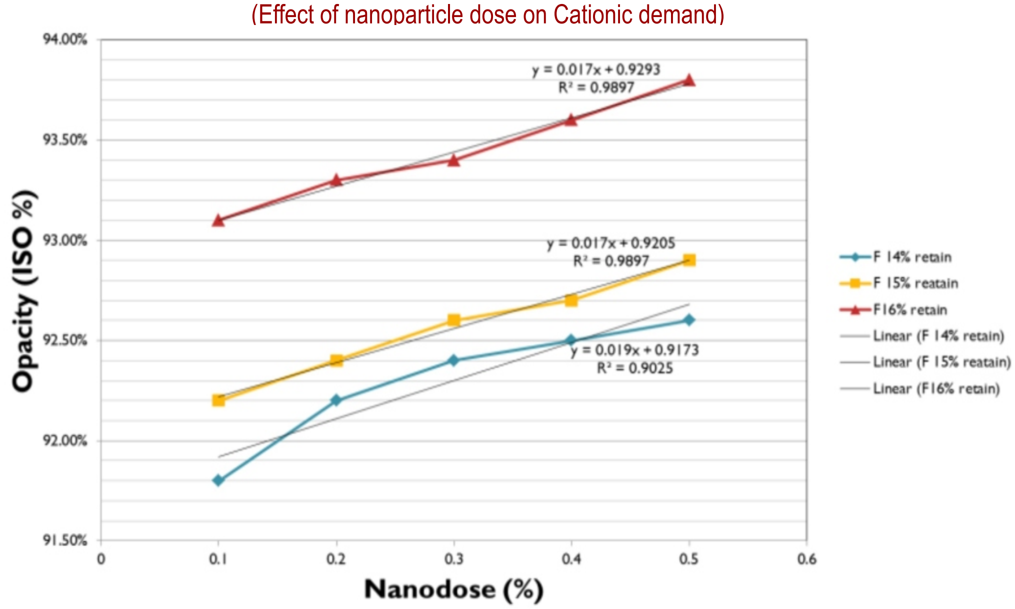
(Effect of different nanoparticle dose on First Pass Ash Retention (FPAR) with different cationic starch levels)



(Effect of nanoparticle dose on drainage with different cationic starch levels)



(Effect of nanoparticle dose on Cationic demand)



(Effect of different nanoparticle dose on opacity of paper at filler retention levels remaining constant (F: amount of filler in %).

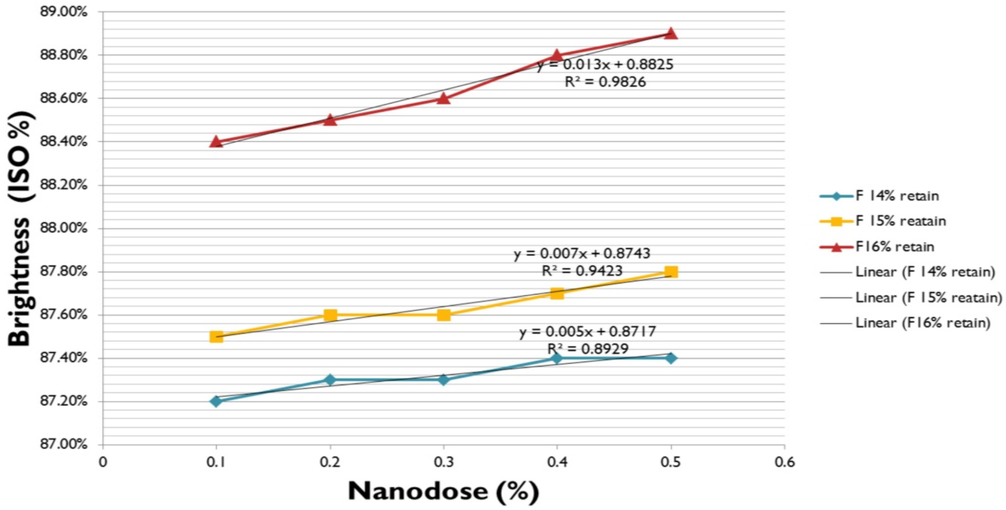
nanosilica and starch system to advance retention, drainage, and strength stated above. But for the case of strength, investigational data shows about how operative the system is in this area. Hence the industrial trial concentrated on the prospective of the nanosilica and cationic starch system to recompense for the negative effects of using higher ash content in fine paper.

Result And Discussion

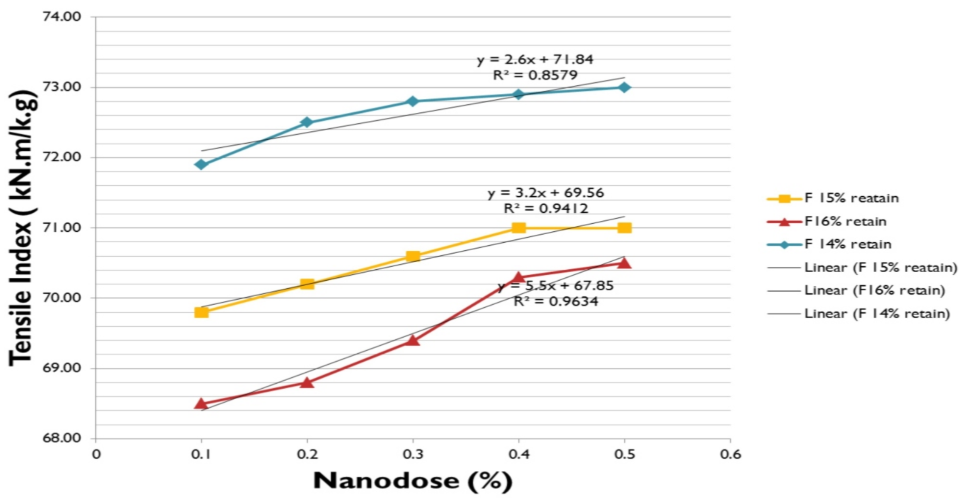
Nanoparticles Effect on Retention or Drainage

The influence of cationic starch on retention and drainage was marginal, but both the drainage and retention drastically changed if nanoparticles were injected into the system. The higher the nanoparticles dosage, the higher was the drainage and retention. It seems that both drainage and retention reached to their maximum at 0.7% cationic starch dosage. Further increase in the cationic starch dosage did not show any remarkable change on either retention or drainage.

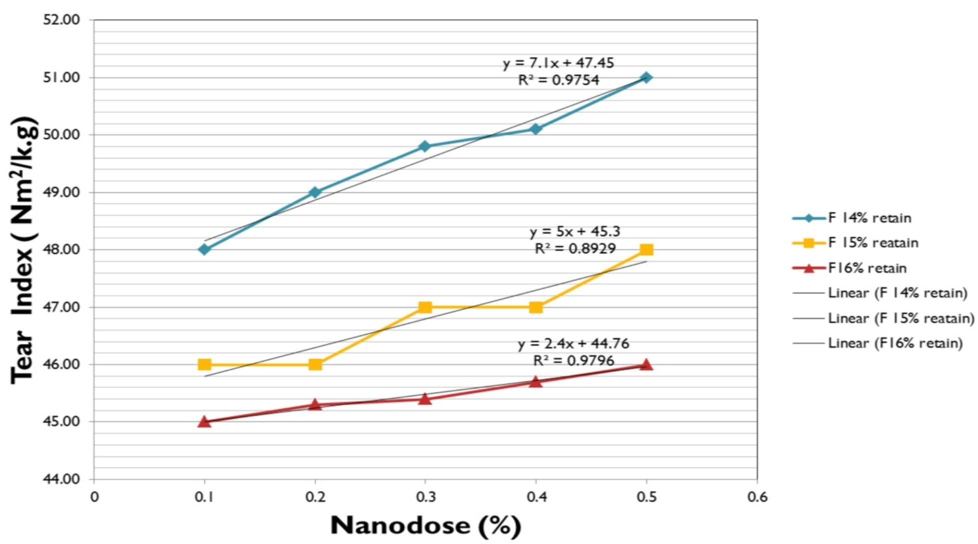
In case of micro particle system in the Trident papers First Pass Retention (FPR) is 69 % when the cationic starch (0.7 %) is used. But in the trial with nano dose (0.1%) the FPR is 72% in case of 0.5 % cationic starch which is increased to 73% in case of 0.6 % cationic starch which is increased to 74% in case of 0.7 % cationic starch. With the nanodose 0.2 % the FPR values are 72%, 73%, 74 % with cationic starch 0.5 %, 0.6%, 0.7% respectively. With the nanodose 0.3% the FPR values are 74%, 75%, 76% with cationic starch 0.5 %, 0.6%, 0.7% respectively. With the nanodose 0.4% the FPR values are 75%, 77%, 78% with cationic starch 0.5 %, 0.6%, 0.7% respectively. With the nanodose 0.5% the FPR values are 79%, 81%, 82% with cationic starch 0.5 %, 0.6%,



(Effect of different nanoparticle dose on brightness of paper at filler retention levels remaining constant (F: amount of filler in %)



(Effect of different nanoparticle dose on Tensile Index of paper at filler retention levels remaining constant (F: amount of filler in %)



(Effect of different nanoparticle dose on Tear Index of paper at filler retention levels remaining constant (F: amount of filler in %)

0.7% respectively.

The cationic charge demand (micro equivalent / liter) increases with increase in nano dose % because nanoparticle is anionic in nature. In the time of trial of the chemical in Trident papers it is found that cationic demand is 41 with the nanodose 0.1% which gradually increased to 42 , 44 ,47,49 with the nanodose 0.2 % ,0.3 %,0.4 % ,0.5 % respectively.

Optical Properties

Ash retention can have probable effect on the optical properties. Higher the filler content higher will be the brightness and opacity. There will be very marginal interruption by the nanoparticle on optical properties if the ash contents were attuned to a constant level. There is no specific inclination followed for the opacity of the paper with the same filler level, as showed in graph. The ebb and flow probably due to variances in grammage which produced due to the irregular formation. With the increase in the filler retention the opacity values increases. In case of 14% filler retention the opacity (ISO) is 91.8% which gradually increased to 92.2 % in 15 % ash retention and 93.1% in 16 % ash retention with the nano dose 0.1 %.similarly with the increment in the nanodose the opacity values also increases. In the constant filler level (F16% retention) the opacity values are 93.1%, 93.3 %, 93.4%, 93.6%, 93.8% in the nano dose 0.1 %,0.2%,0.3 %,0.4%,0.5% respectively.

Conclusion

Anionic Nano silica particles, contrasting cationic starch, frolicked a substantial role in retention and drainage, but only if it was used in a system that contained high molecular weight cationic starch. The mechanism accountable for the gain was presumed to be bridging and charge neutralization. It was contingent that bridging played a noteworthy role in the development of micro flocculation. Addition of fine particles i.e., nanoparticles to a system including high molecular weight cationic polyelectrolyte further activated the bridging mechanism. It was concluded that micro flocculation i.e., fines and fillers collection through high molecular weight cationic polyelectrolyte) is accountable for the observed gain in retention and drainage. Micro flocculation through accumulation of fines and fillers adapts the wet end network to an open network similar to a fines-free network, thus making the system approachable to both retention and drainage. According to the trial of compozil system in Trident papers it is found that the influence of cationic starch on retention and drainage was marginal, but both the drainage and retention drastically changed if nanoparticles were injected into the system. The higher the nanoparticles dosage, the higher was the drainage and retention. It seems that both drainage and retention reached to their maximum at 0.7% cationic starch dosage. It is optimized that the retention and drainage is maximum at 0.7 % cationic starch with 0.5% nanodose and the paper properties are outstanding in this dose.

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