**Development of amino-functionalized silica nanoparticles for efficient and rapid removal of COD from pre-treated palm oil effluent**

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| **Table S1 – Characteristics of Aerobic treated POME** | |
| **Parameters** | **Valueb** |
| Temperature °C | 25.9 |
| pH | 8.7 |
| BOD@30°Cmg/L | 800 |
| COD mg/L | 2500 |
| Suspended solids mg/L | 150 |
| Total solids mg/L | 2430 |
| Ammoniacal Nitrogen mg/L | 5.2 |
| Total Nitrogen | 13.0 |
| Oil and grease | 5.2 |

bPretreated POME sample collected in June, 2016

***S1.1. Theoretical assumptions***

Among the four different combinations of gelator precursors and surface modifiers the best results were obtained using TMOS/APTMS combination. These results are in accordance with the study of Hasegawa and Sakka [[1](#_ENREF_1)] where they reported that branching and increasing of the chain length lowers the hydrolysis rate and consequently the rate of reaction slower down and efficiency of the reaction decreases:

Si(OMe)4 > Si(OEt)4 > Si(OnPr )4 > Si(OiPr)4 > Si(OnBu)4 > Si(OHex)4

Another clue that supports the reaction efficacy among TMOS/APTMS is that the stability of reaction intermediate formed during the course of reaction. As shown in the scheme S1, in base catalyzed reactions a negatively charged intermediate is formed. So, longer chain alkyl groups destabilize the intermediate due to Hyperconjugation and ultimately the efficiency of reaction decrease. In this particular case, shorter chain alkyl group contribute less towards the destability and comparatively the intermediate produced during the course of reaction is stable as compared to longer chain alkyl group. Stability of intermediate reflects the efficiency of reaction rate and ultimate the efficiency of the reaction. Herein, in case of product A, the precursors have shortest chains of alkly and alkoxy groups and have lesser effect on the destabilization of intermediate. Consequently, the rate of reaction is maximum in case of product A and the product was obtained with higher yields.

SEM images and FTIR results and theoretical assumptions are evidences of maximum yield, more monodispersity and higher loading of aminomodification of silica particles. So for further characterization and reactions AFS-NPs of TMOS/APTMS combination were used.

Hydrolysis



Polycondensation





**Scheme S1 – Schematic representation of the base catalyzed Sol-Gel process mechanism**



**Fig. S1 – Histograms showing particles size distribution of AFS-NPs from four combinations (a) TMOS+APTMS, (b) TEOS+APTES, (c) TMOS+APTES (d) TEOS + APTMS**



**Fig. S2 – FTIR Spectra of AFS-NPs (product A) before and after calcination**

[1] Hasegawa I, Sakka S, Sugahara Y, Kuroda K, Kato C. Polymerization of hydrolysis products of methyltriethoxysilane in aqueous solutions. Journal of the Ceramic Society of Japan 1990;98:647-52.