



DOI: 10.5604/01.3001.0016.1392

Stability analysis of hybrid $\text{Al}_2\text{O}_3\text{-TiO}_2$ nano-cutting fluids

A. Arifuddin ^a, A.A.M. Redhwan ^{a,*}, A.M. Syafiq ^a,
S. Zainal Ariffin ^a, A.R.M. Aminullah ^a, W.H. Azmi ^{b,c}

^a Faculty of Engineering Technology, University College TATI (UC TATI),
24000 Kemaman Terengganu, Malaysia

^b Department of Mechanical Engineering, College of Engineering, Universiti Malaysia Pahang,
Lebuhraya Tun Razak, 26300 Gambang Kuantan, Pahang, Malaysia

^c Centre of Excellence for Advanced Research in Fluid Flow, Lebuhraya Tun Razak,
26300 Kuantan, Pahang, Malaysia

* Corresponding e-mail address: redhwan@uctati.edu.my, redhwan323@gmail.com

ORCID identifier:  <https://orcid.org/0000-0003-3133-0208> (A.A.M.R.)

ABSTRACT

Purpose: This paper is to study the stability of the current combination of hybrid nano-cutting fluids due to the recent progress in the analysis of nano-cutting fluids, such as the assessment methods for the stability of nano-cutting fluids, have revealed that instability is a common problem associated with nano cutting fluids.

Design/methodology/approach: Five samples of 0.001 vol% that are suitable to be tested at UV-Vis machine, $\text{Al}_2\text{O}_3\text{-TiO}_2$ hybrid nano-cutting fluid was prepared using a one-step process with the help of a magnetic stirrer to stir for 30 minutes with different sonication time to determine the best or optimum sonication time for this hybrid nano-cutting fluid. Stability of nano-cutting fluids was analysed using UV-Vis spectrophotometer (0.001%, 0.0001%, 0.00001%), visual sedimentation (1%, 2%, 3%, 4%), TEM photograph capturing techniques (2%) and zeta potential analysis (0.001%, 0.00001%), that used different volume concentration that is suitable for each type of stability analysis.

Findings: The stability analysis reveals that the best sonication time is 90 minutes, and the UV-vis spectrophotometer shows the stability of all samples is above 80% during a month compared to the initial value. Further, visual sedimentation shows good stability with minimum sedimentation and colour separation only. The zeta potential value also shows great stability with a value of 37.6 mV. It is found that the hybrid nano-cutting fluid is stable for more than a month when the nano is suspended in the base fluid of conventional coolant.

Research limitations/implications: The result in this paper is based on the experimental study of $\text{Al}_2\text{O}_3\text{-TiO}_2\text{/CNC}$ coolant base hybrid nano-cutting fluid for a month. However, to further validate the results presented in this paper, it is recommended to prolong the stability assessment time for six months for longer shelf life.

Practical implications: The finding of this experimental study can be useful for high-precision product machining using similar CNC coolants, especially for aircraft and aerospace applications for machining parts.

Originality/value: No thorough stability assessment using all four types of stability analysis is done on $\text{Al}_2\text{O}_3\text{-TiO}_2\text{/CNC}$ Coolant base hybrid nano cutting fluid.

