

Electroless nickel-phosphorous coatings are widely used in many of the industrial applications because of their unique properties, including high wear resistance, high corrosion resistance, highly hardness and toughness properties, and good lubrication. By combining nano-sized particles as a reinforcing phase inside the Ni-P matrix, a functional nanometer composite coating is produced by an electroless codeposition process. The combined properties of the Ni-P coating are mainly improved and sometimes new features are fully added to the coating performance. For this purpose, different nanoparticles like nano-SiC, WC, Al₂O₃, TiO₂, and ZnO increase as hardener particles in the coatings, and nanoparticles such as PTFE, MoS₂, and graphite as lubrication particles are added for the coatings. Of these nanoparticles, PTFE has aroused tremendous interest due to its properties, including low surface energy and lower friction coefficient, (good for non-stick surfaces or and dry lubricants), anti-fouling properties, and very good wear and corrosion resistance. Ni-P-PTFE can be used as an anti-sticking coating. The condensed fluorine atoms in these molecules at the outer layer are the main cause of the physical properties of PTFE polymer like its low surface energy and very its remarkably lower friction coefficient. By co-deposition of PTFE in the matrix of the coating, the properties of both Ni-P and PTFE can be used simultaneously. PTFE has excellent anti-stick properties due to the low surface energy of PTFE polymer (18.6 mN/m). The potential application of a Ni-P-PTFE composite is to the reduction of fouling. For example, is foreseen as a solution to the serious problem of the formation of deposits resembling limestone on the surfaces of heat exchangers or heat-exchange elements is a serious problem. These sediments are one of the inherent problems in the designation and operation of many types of production and processing equipments and processes. These unwanted sediments can affect the equipment in two ways are:

- The lower thermal conductivity of the formed sediments can increase heat-transfer resistance for heat transfer, and therefore reduces the heat-exchanger efficiency of heat-exchanging exchangers.

Comment [A1]: In the passive voice, adverbs of manner are generally placed between the helping and main verbs or after the verb phrase. For example, The heart tissue was carefully examined to The heart tissue was examined carefully.

Comment [A2]: To use the colon correctly, you must make sure that the sentence that comes before the colon is a complete, grammatical sentence.

- Fouling the ducts reduces the cross-sectional area of the fluid path, causing and the increased friction becomes higher, causing to an increase of and a pressure drop across the system.

Comment [A3]: Redundant phrases make a sentence wordy. Being economical in writing enhances clarity (in terms of meaning) and readability of the sentence.

Any methods for reducing such sediments sedimentary build-up can decrease costs. We found that the adhesion of the formed such sediments on the surfaces with low surface energy is poor. For this purpose, therefore, many polymeric coatings have been used. The lower thermal conductivity, and low wear resistance as well as and poor adhesion of to the substrate of the conventional polymer coatings have limited their industrial applications. Since Because Ni-P-PTFE coating is metallic-based on a metallic composite, its thermal conductivity, mechanical strength, and wear-resistant properties are much bigger better than PTFE coatings, while and it also has a less low surface energy.