

Recent Advances in Tool Coatings and Materials for Superior Performance in Machining Nickel-Based Alloys

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INTRODUCTION & AIM

- Nickel-based alloys (Inconel 718, 625, Incoloy 825) are critical in aerospace and energy sectors.
- High strength and corrosion resistance but poor machinability.
- Challenges: High temperatures, rapid work hardening, fast tool wear.
- Tool coatings enhance tool life, reduce wear, and improve performance.

METHOD

- Focus areas:
 - PVD, CVD, nanocomposite, and hybrid coatings.
 - Tool life, wear resistance, machining parameters.
 - Theoretical modeling and case studies.



Figure1 : Tool coating overview for nickel base alloy

RESULTS & DISCUSSION

- TiAlSiN: +80% tool life (Inconel 718), +60% (Inconel 625).
- CrAlSiN: +200% tool life (Inconel 617).
- TiAlN/TiN: High-speed performance, wear resistance.
- CVD coatings: Good but less effective than PVD.
- 70° tool geometry shows slower wear than 90°.
- Innovations: Ti₃AlN doped with Cr, V, Nb.

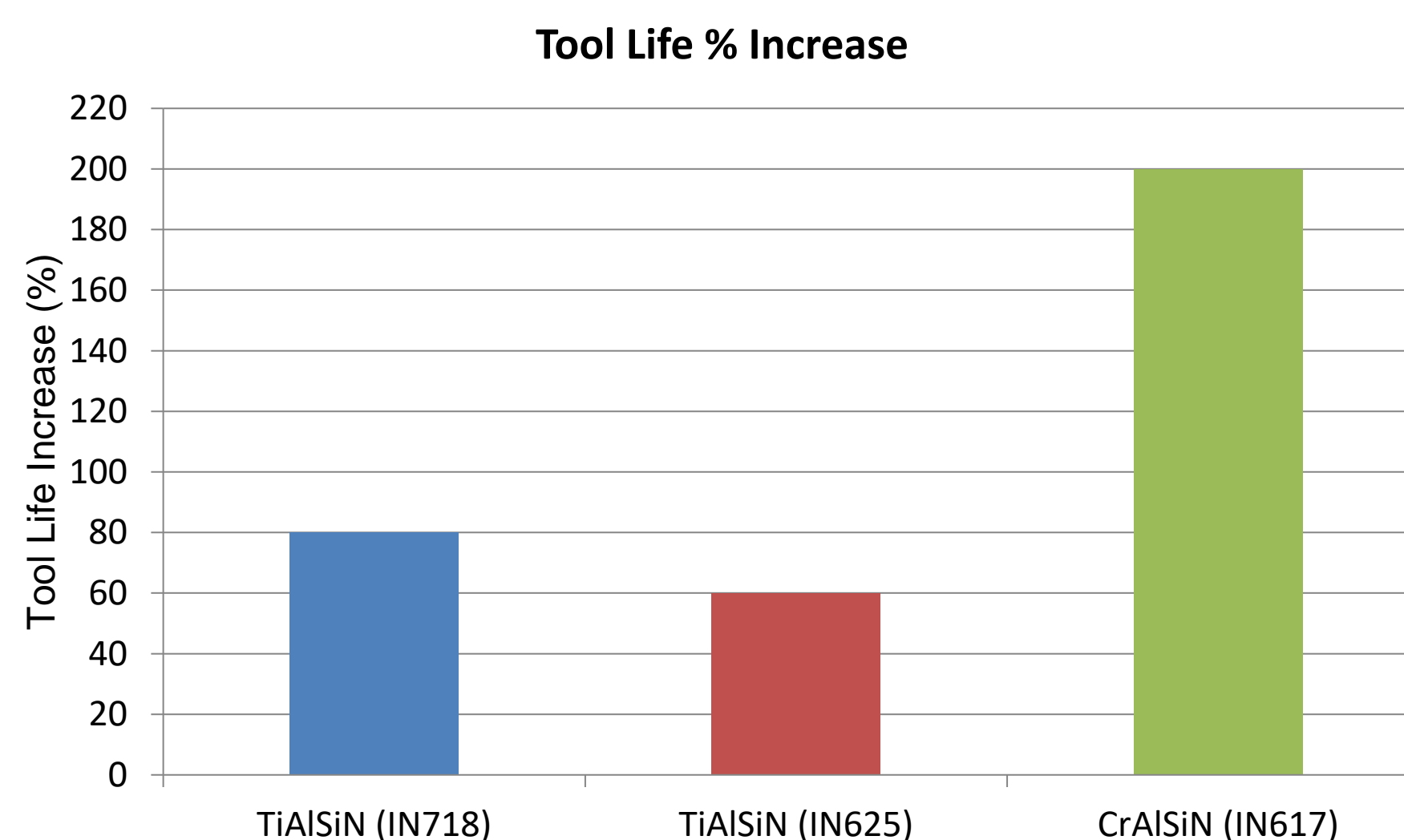


Figure2 : Tool Life Improvement by Coating Type

CONCLUSION

- PVD coatings (TiAlN/TiN, TiAlSiN, CrAlSiN) perform best.
- Nanocomposites and doped coatings show future potential.
- Tool geometry and cutting parameters also critical.
- Continued innovation needed for high-efficiency machining.

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