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AUGMENTATION OF DEPTH OF PENETRATION AND PRODUCTIVITY BENEFITS OF ATIG WELDS USING THE AHP

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Abstract
Weldability is an important issue in the fabrication of different grades of stainless steel used in industry. Tungsten inert gas (TIG) welding is widely used in industry for accurate and precision work, but lack of penetration is observed in this process even though current and welding speed can be varied considerably to increase heat input to obtain deeper penetration. Increased heat input adversely affects mechanical properties of the weldment. To overcome this, activated flux TIG welding is often used in industry to achieve higher depth of penetration with relatively less heat input. In this study, activated flux TIG welding is used with input variables such as heat input, welding speed and pulse frequency. The chosen base metal is SS 304L stainless steel, and a hybrid flux mixture containing fluxes of SiO2, MnO2 and MoO3 in a ratio of 1:1:2 is used to obtain the desired depth of penetration. Nine experimental runs are conducted to obtain the optimum depth of penetration. Heat input values are 2.767 kJ/mm, 1.470 kJ/mm and 1.281 kJ/mm and pulse frequency is 160 Hz, 120 Hz and 80 Hz. Welding speed varies from 0.5 mm/s to 1.18 mm/s. A maximum depth of penetration of 4.42 mm is achieved with a heat input of 2.767 kJ/mm, welding speed of 0.5 mm/s and pulse frequency of 160 Hz. The reversed Marangoni effect and arc constriction effect are the mechanisms responsible for the deeper penetration in ATIG welding. In this research, a multi criteria decision making tool, the Analytical Hierarchy Process (AHP), is used to validate the optimum value obtained. The optimal values obtained in the research are in good accordance with those obtained using the AHP. The outcome of the present investigation indicates the applicability of ATIG welding for joining large thickness of stainless steel flats to give enhanced productivity by reducing the number of weld passes.

Author Keywords
AHP; arc constriction effect; ATIG; hybrid flux; penetration; reversed Marangoni effect

References

- Acharya, S., Gonda, D., Das, S.
Artificial neural networks based prediction of penetration in activated tungsten inert gas welding
(2024) *Indian Welding Journal*, 57 (1), pp. 71-79.
- Acharya, S., Gonda, D., Das, S.
Achieving favourable depth of penetration and productivity of ATIG welds utilising the AHP
(2022) *Indian Science Cruiser*, 36 (5), pp. 17-23.
- Acharya, S., Das, S.
Effect of activating flux in gas tungsten arc welding
(2020) *Weld Fab Tech Times*, 4, pp. 12-21.
- Afolalu, S.A., Samel, O.D., Ikumarpayi, O.M.
Development and characterization of nano-flux welding powder from calcined coconut shell ash mixture with FeO particles
(2020) *Journal of Materials Research and Technology*, 9, pp. 9232-9241.
- Babbar, A., Kumar, A., Jain, V., Gupta, D.
Enhancement of activated tungsten inert gas (A-TIG) welding using multi-component TiO2-SiO2-Al2O3 hybrid flux
(2019) *Measurement*, 148, pp. 1-16.

- Bhattacharya, S., Sabiruddin, K., Das, S.
Optimal selection of metal active gas welding parameters in joining high carbon steel: Through the AHP
(2021) *Indian Science Cruiser*, 35 (5), pp. 27-36.

- Biswas, N., Das, S.
Selection of process parameters for welding P91 steel pipes using the analytical heirarchy process
(2011) *Reason- A Technical Magazine*, 10, pp. 7-12.

- Capraz, O., Dagur Meran, C., Wörner, W., Gungor, A.
Using AHP and TOPSIS to evaluate welding processes for manufacturing plain carbon stainless steel storage tank
(2015) *Archives of Materials Science and Engineering*, 76, pp. 157-162.

- Das, S., Islam, R., Chattopadhyay, A. B.
A simple approach for on-line tool wear monitoring using the analytic hierarchy process, Proceedings of the IMechE
(1997) *Journal of Engineering Manufacture*, 211 (B1), pp. 19-27.

- Dagur, H., Kumar, R., Singh, V., Chauhan, S., Deep, A., Dixit Patel, D., Forman, F.H.
Effect of TIG and activated flux TIG welding processes on weld bead geometry, microstructure, and hardness of SAF 2507 grade super duplex stainless steel joint
(1990) *Engineering Research Express*, 5, pp. 1-16.

- Gadewar, S.P., Swaminadhan, P., Harkar, M.G., Gawande, S.H.
Experimental investigations of weld characteristics for a single pass TIG welding with SS304
(2010) *International Journal of Engineering Science*, 2, pp. 3676-3686.

- Golden, B.L., Wasil, E.A., Lavy, D.E.
Applications of the analytic hierarchy process: A categorized, annotated bibliography
(1989) *The Analytic Hierarchy Process: Applications and Studies*, pp. 37-58.
BL Golden, EA Wasil, PT Harker (Eds), –). Berlin: Spinger-Verlag Annonated

- Her-Yueh, H.
Effects of shielding gas composition and activating flux on GTAW weldments
(2009) *Materials and Design*, 30, pp. 2404-2409.

- Lai, X., Ji, C., Luo, X., Deng, L.
Application of AHP method of orthogonal trial to selection of parameters in resistance spot welding
(2009) *Electric Welding Machine*, 49, pp. 7-8.

- Lin, H.L., Wu, T.M.
Effects of activating flux on weld bead geometry of Inconel 718 alloy TIG welds
(2012) *Materials and Manufacturing Processes*, 27, pp. 1457-1461.

- Liu, X., Gong, S.L.
Evaluation on the effect of weld shape on fatigue performance by analytic hierarchy process
(2011) *Advanced Materials Research*, 146 (147), pp. 1839-1842.

- Modenesi, P. J., EustaAquio, R. A., Pereira, I. M.
TIG welding with single-component fluxes
(2000) *Materials Processing Technology*, 99, pp. 260-265.

- Mondal, C., Bhattacharya, S., Das, S.
Parametric optimization of spot welding of 17-4 PH stainless steels using the

analytic hierarchy process
(2011) *Indian Welding Journal*, 44 (4), pp. 69-78.

- Morisada, Y., Fujii, H., Xukun, N.
Development of simplified active flux tungsten inert gas welding for deep penetration
(2014) *Material Design*, 54, pp. 526-530.

- Niagai, J.
Influence of activated fluxes on the bead shape of A-TIG welds on carbon and low-alloy steels in comparison with stainless steel AISI 304L
(2021) *Metals*, 11, pp. 1-13.

- Patel, D., Jani, S., Singh, V., Ashutosh, S.
Develop a sustainable welding procedure for chromium manganese austenitic stainless steel using the ATIG process
(2021) *Engineering Research Express*, 3, pp. 1-12.

- Paulo, J M., Eustáquio, R A., Iaci, M P.
TIG welding with single-component fluxes
(2000) *Journal of Materials Processing Technology*, 99, pp. 260-265.

- Ramkumar, k.D., Varma, V., Prasad, M., Rajan, N.D., Shanmugam, N.S.
(2018) *Effect of activated flux on penetration depth, microstructure and mechanical properties of*,

- **Ti-6Al-4V TIG welds**
Journal of Materials Processing Technology, 261, pp. 233-241.

- Ravisankar, V., Ravisankar, V., Muralidharan, C.
Selection of welding process to fabricate butt joints of high strength aluminium alloys using analytic hierarchy process
(2006) *Materials & Design*, 27, pp. 373-380.

- Ruckert, G., Huneau, B., Marya, S., Rückert, G., Huneau, B., Marya, S., Ru, G., Huneau, B.
Optimising the design of silica coating for productivity gains during the TIG welding of a 304 L stainless steel
(2007) *Materials & Design*, 28, pp. 2387-2393.
Marya,, S

- Saaty, T.L.
A scaling method for priorities in hierarchical structure
(1977) *Journal of Mathematical Psychology*, 15, pp. 234-281.

- Saaty, T.L
(1980) *Analytic Hierarchy Process*,
NewYork: McGraw-Hill

- Saaty, T.L.
An essay on how judgement and measurement are different in science and in decision making
(2009) *International Journal of the Analytic Hierarchy Process*, 1 (1), pp. 61-62.

- Sabiruddin, K., Bhattacharya, A., Das, S.
Selection of appropriate process parameters for gas metal arc welding of medium carbon steel specimens
(2013) *International Journal of the Analytic Hierarchy Process*, 5 (2), pp. 252-267.

- Sabiruddin, K., Das, S., Bhattacharya, A.
Application of the analytic hierarchic process for optimization of process

parameters in GMAW
(2009) *Indian Welding Journal*, 42 (1), pp. 38-46.

- Saha, S., Das, S.
Investigation on the effect of activating flux on tungsten inert gas welding of austenitic stainless steel using AC polarity
(2018) *Indian Welding Journal*, 51 (2), pp. 84-92.

- Saha, S., Das, S.
Application of activated tungsten inert gas (A-TIG) welding towards improved weld bead morphology in stainless steel specimens
(2019) *Annual Technical Volume of Production Division Board, The Institution of Engineers (India)*, IV, pp. 13-23.
http://dx.doi.org

- Saha, S., Das, S.
Effect of polarity and oxide fluxes on weld-bead geometry in activated tungsten inert gas (A-TIG) welding
(2020) *Journal of Welding and Joining*, 38 (4), pp. 380-388.
http://dx.doi.org

- Saha, S., Paul, B.C., Das, S.
Productivity improvement in butt joining of thick stainless steel plates through the usage of activated TIG welding
(2021) *SN Applied Sciences*, 3 (416).
416/1-10

- Singh, A.K., Dey, V., Rai, R.N.
(2017) *Techniques to improve weld penetration in*,

- *Materials Today: Proceedings*, 4, pp. 1252-1259.

- Stevens, S.S.
On the theory of scales of measurement
(1946) *Science*, 103, pp. 677-680.

- Tversky, A., Kahneman, D.
Rational choice and the framing of decisions
(1988) *Decision making: descriptive, normative and prescriptive interactions*, pp. 167-192.
DE Bell. H Raiffa and A Tversky (Eds), –). Cambridge: Cambridge University Press

- Vargas, L.G.
An overview of the Analytic Hierarchy Process and its applications
(1990) *European Journal of Operational Research*, 48, pp. 72-80.

- Vasudevan, M.
Effect of A-TIG welding process on the weld attributes of Type 304 LN and 316 LN stainless steels
(2017) *Journal of Material Engineering Performance*, 26, pp. 1325-1336.

- Vidyarthy, R.S., Dwivedi, D.K.
Microstructural and mechanical properties assessment of the P91 A-TIG welds joints
(2018) *Journal of Manufacturing Process*, 31, pp. 523-535.

- Vora, J., Patel, V.K., Srinivasan, S., Chaudhari, R., Pimenov, D.Y., Giasin, K., Sharma, S.
Optimization of activated tungsten inert gas welding process parameters using heat transfer search algorithm: with experimental validation using case studies
(2021) *Metals*, 11 (6).
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