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Aluminium hot extrusion process capability improvement using Six Sigma

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ABSTRACT

In this work, the Six Sigma (Define-Measure-Analyse-Improve-Control) DMAIC methodology has been followed to explain the original problem of lowering extrusion process variation and improving the process capability based on the determined Critical Quality Characteristics (CQC). The extrusion process charter worksheet is recognized, a SIPOC (Supplier-Input-Process-Output-Customer) chart is constructed and a Pareto chart is drawn in the Define phase of the methodology. Measurement data are collected, verifying process stability and verifying process normality by using $\overline{X}$-R charts and normality test, respectively. Process capacity index, sigma levels, defects per million opportunities (DPMO) determination in the measure phase using a Histogram. During Analyse phase, Cause and Effect diagram are established to determine their likelihood for the root cause of aluminium extrusion defective products. The suggested solutions are installed in the improve phase. In the Control phase, all tools are applied in the Measure phase are repeated to determine the improvement level. The DMAIC methodology has been applied in the (Ur state company for engineering industries)/(aluminium extrusion factory). The Minitab 16 Software is used for calculations and plot charts. The results for the internal dimension (X1) of the corner section product indicate a reduction in DPMO from 536804 to 185795.09, sigma level is improved from 1.4 to 2.4, process yield (Y) is improved from 46 % to 81 %, and profit is improved from ID 127.000 to ID 223.000 per 1000 kg.

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Strokovni članek

Izboljšanje postopka vročega ekstrudiranja aluminija z uporabo metode šest sigma

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POVZETEK

V prispevku smo uporabili metodo šest sigma (definiraj-izmeri-analiziraj-izboljšaj-nadzoruj) za večjo stabilnost tehnološkega procesa in izboljšanje postopka vročega ekstrudiranja aluminija, temelječe na določitvi kritične karakteristike kakovosti (CQC). V fazi *definiraj* smo izdelali delovni list procesa ekstrudiranja, graf SIPOC (dobavitelj-vhod-proces-izhod-kupec) in Paretov diagram. Zajeli smo podatke merjenj in verificirali stabilnost procesa oziroma testirali normalnost distribucije z uporabo $\overline{X}$-R grafov oziroma testa normalnosti. V fazi *izmeri* smo določili indeks sposobnosti procesa, nivoje sigma in število napak na milijon možnosti (DPMO). Da bi ugotovili temeljni razlog za defektne izdelek smo med fazo *analiziraj* izdelali diagram *vzrok-posledica*. Predlagane rešitve smo upoštevali v fazi *izboljšaj*. V fazi *nadzoruj* smo ponovili vse aktivnosti iz faze *izmeri*, da bi ugotovili raven izboljšanja procesa. DMAIC metodologija je bila vpeljana v iraški firmi *Ur state company for engineering industries/aluminium extrusion factory*. Za preračune in izdelavo grafov je bila uporabljena programska oprema Minitab 16. Rezultati za notranjo dimenzijo (X1) robnega preseka izdelka kažejo zmanjšanje DPMO od 536804 na 185795.09, nivo sigma se je povečal od 1.4 na 2.4, izkoristek procesa (Y) od 46 % na 81 %, dobiček pa od ID 127.000 na ID 223.000 na 1000 kg.

PODATKI O ČLANKU

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