Numerical and Experimental Investigation of tubes flow forming process

M.-A. Vidal*[a,b], P.-O. Bouchard[a], F. Frascati[b], J.-P. Mallet[b], F. Fournier[a], A. Pignolet[a], K. Mocellin[a]

a. CEMEF Mines ParisTech, PSL Research University, CNRS UMR 7635, CS 10207, 06904 Sophia-Antipolis Cedex, France

b. MBDA France, Rond-Point Marcel Hanriot, 18020 Bourges Cedex, France

MOTS CLES: flow forming ; incremental ; modeling ; complex loading path ; ductile fracture.

RESUME

Flow forming is a tube forming process used to produce thin-walled tubes with good mechanical properties resulting from strain hardening induced by the process. Flow-formed tubes are mainly used for aeronautics because they allow lightening structures with the same mechanical characteristics as heavier tubes produced by other ways. Understanding the mechanics of flow forming is essential for a correct modeling of the material behavior during the process and for defining optimal process conditions for a large range of materials.

Flow forming involves a tubular preform clamped on a rotating mandrel. Three rollers are placed at 120° from each other around the preform. These rollers are moving along the revolution axis of the mandrel, thus reducing the preform thickness and elongating the tube. Because of the tools kinetics, the material undergoes different stress states during the process: tension, compression and shear. An accurate numerical modeling of the process would enable to identify this complex loading path and therefore would allow defining adapted mechanical tests for the identification of materials behavior and the analysis of ductile fracture under such multiaxial and incremental loading conditions. The validation of such simulations requires reliable experimental data. Flow forming experiments with different process parameters are therefore performed to compare the influence of those parameters on the flow formability of tubes [1]. As this study is carried out with an industrial partner, comparison between the industrial flow forming machine and a laboratory flow forming device developed in CEMEF will be made [2].

REFERENCES

[1] DAVIDSON, M. J., BALASUBRAMANIAN, K., TAGORE, G.R.N. Experimental investigation on flow-forming of AA6061 alloy - A Taguchi approach. *Journal of Materials Processing Technology*, 2008, vol. 200. n°1-3, p. 283-287.

[2] DEPRIESTER, D. Caractérisation et modélisation du procédé de fluotournage inverse à froid du TA6V. Thèse de doctorat : sciences et génie des matériaux. Paris : école des Mines de Paris, 2014.

*corresponding author: marie-anne.vidal@mines-paristech.fr