

JOIN'EM

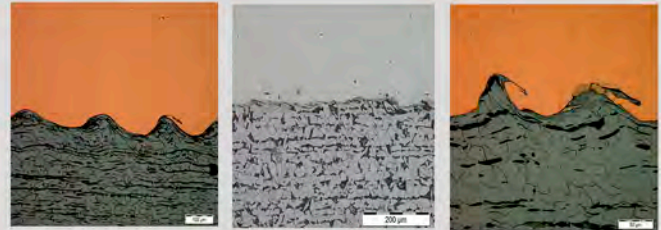
INDUSTRIAL TECHNOLOGIES FOR ADVANCED JOINING AND ASSEMBLY PROCESSES FOR MULTI-MATERIALS



JOIN'EM PROJECT
NEWSLETTER #2

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Advances Brought by JOIN'EM



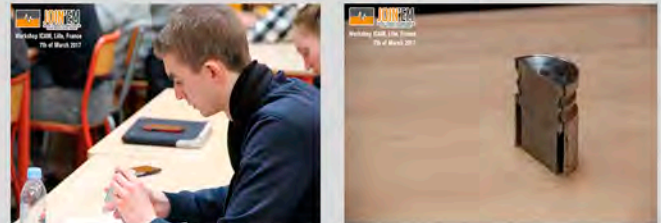
2. JOIN'EM Events

Environmental aspects of EMW presented at the LCM Conference in Luxembourg



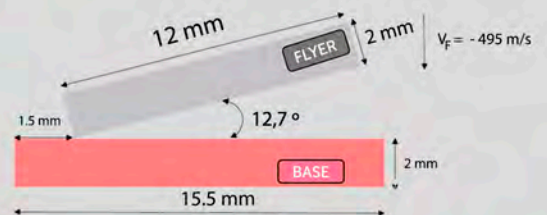
3. JOIN'EM Workshop

Second training workshop for engineering students held in France



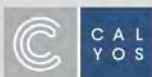
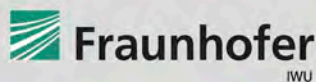
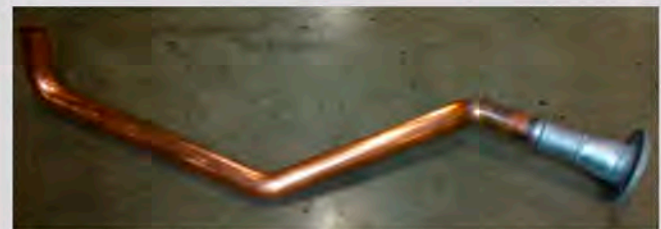
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ICAM participates in MSC Software's Simulating Reality Contest 2017



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REFCO demonstrator - CASE 1
WHIRLPOOL demonstrator - CASE 2



The JOIN'EM project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. H2020-FoF-2014-677660 — JOIN-EM

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PROJECT SUMMARY

JOIN'EM addresses the increasing requirements of industrial enterprises to weld dissimilar materials. This EU-funded project aims at facilitating aluminium-copper joining by electromagnetic fields resulting in increased performance, efficiency and environmental benefits to Europe's industry.



Objectives: Global trends are forcing industry to manufacture lighter, safer, more environmentally friendly, more performant and cheaper products: the manufacturing systems engineering sector is aiming at better performing



Impact: Due to its excellent thermal and electrical properties, copper is the 3rd most frequently used raw material in the world. JOIN'EM directly aims at decreasing the consumption of this high cost material by partially substituting it with aluminium.



Implementation: JOIN'EM is oriented towards an integrated data exchange, with 6 mainly technical and 3 additional more organisationally oriented work packages focussing on implementation, dissemination, exploitation and project management.

Advances Brought by JOIN'EM

Up to now, EMW tool design and manufacturing was carried out by means of trial and error, but without considering the service life and the behaviour of the used materials and components. Within JOIN'EM, the developed knowledge will be applied in order to achieve a more professional approach. This will be provided by:

1

Quantitative prediction of the electrical, mechanical and if necessary also thermal loads acting on the tools by means of numerical simulation.

For this purpose, numerical simulation of EMW will be further developed, especially focusing on a detailed modeling of the tool components, which will be considered as deformable structures and no longer as rigid bodies only.

Quantitative
Lead Prediction

2

Determination of data about the fatigue performance of materials applied in tool manufacturing.

This concerns mainly copper alloys for the conducting parts and fibre-reinforced plastics for the housing components. Data about fatigue performance of these materials is scarce in literature.

Data
Determination

3

Improvement of the durability and functionality by means of suitable treatments and design.

This will be based on the proved enhancement of the fatigue life due to surface treatment by shot or laser peening and delayed fretting fatigue by cryogenic treatment or chromium nitride coating.

Improvement

4

Numerical simulations were carried out for tools and tool components, subjected to fatigue loading conditions.

Durability
Analysis

Environmental aspects of EMW Joining Technologies presented at the **LCM Conference in Luxembourg**



The JOIN'EM project will be presented at the 8th International Conference on Life Cycle Management (LCM 2017), which will take place in Luxembourg, at the European Convention Center, during 3rd - 6th of September.

This LCM series is the leading forum worldwide bringing together 600+ scholars and practitioners from 40+ countries working in industry, academia and public institutions in the domain of life cycle sustainability and circular economy. It takes place every second year, each time organised by a leading research institution and industry in the domain.

JOIN'EM will be presented through an oral presentation: LCA of state-of-the-art joining technologies, during the session: "Best practices for Sustainable Design: integrating LCM into the innovation processes". The presentation will be held by one of the project consortium' member, Vertech Group.

The Life Cycle Management conferences are established as one of the leading conference series worldwide in the field of environmental, economic and social sustainability. The unique feature of LCM is developing practical solutions for the implementation of life cycle approaches into strategic and operational decision-making. The Life Cycle Conference is for international decision-makers from science, industry, NGOs and public bodies.



JOIN'EM WORKSHOP

Second training workshop for engineering students held in France

The partners of the H2020 Factories of the Future project JOIN'EM have organised the second training workshop for engineering students. This time, the workshop was hosted by ICAM, in Lille, France.



The event, held on March 7th, 2017, had more than 40 participants. The aim of the workshop is to show to Engineering students what JOIN'EM is all about, and how interesting Electromagnetic Welding (EMW) is. The students had the opportunity to analyse several welded samples, in different materials and joint configurations, showing real world applications for EMW.

The workshop presentations were made by the Belgian Welding Institute and Fraunhofer IWU.

4

SPECS

RESULTS & VALIDATION

ICAM participates in MSC Software's Simulating Reality Contest 2017

One of the JOIN'EM partners has submitted their findings in a worldwide contest from the well-known MSC Software company (Simulating Reality Contest 2017). The work is focused on numerical simulation of fully coupled thermal-mechanical transient analysis, using MSC Software FEA software MSC Marc Mentat 2017. Numerical results of magnetic pulse welding cases were compared to two experimental test cases from Fraunhofer IWU.

SPECIFICATIONS

Flyer: Aluminium
Base: Copper



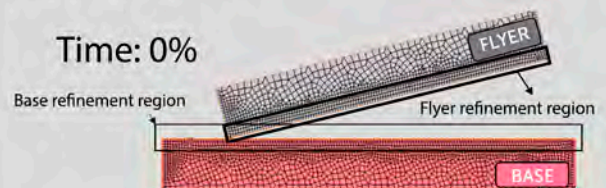
Simulation Specifications:

- 2D solid global remeshing.
- Johnson-Cook constitutive law.
- Process duration : 7 μ s.
- Number of elements:
 - Flyer: 2826
 - Base: 7025
- Minimum Edge Length (MEL) : 60 μ m

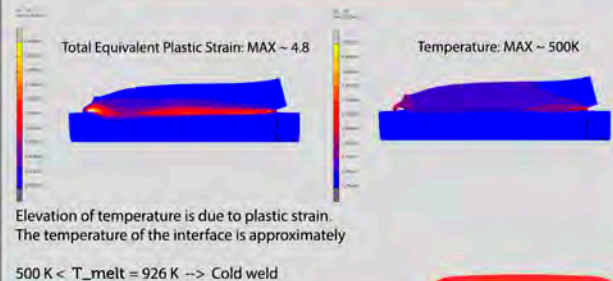
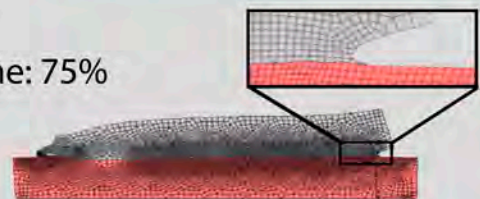
Boundary Conditions:

- Structural
 - Null displacement fixed for the bottom of the base
 - Vertical gravity load for both the base and the flyer
- Thermal
 - Fixed temperature of 296 K for the bottom of the base
 - Plastic heat generation for both the base and the flyer (correction factor of 0,9)
 - Adiabatic condition (Only conduction is considered due to the rapidity of the processes (μ s))

RESULTS



Time: 75%



PLAY ME!



EXPERIMENTAL VALIDATION

NUMERICAL



EXPERIMENTAL



Reproduced, courtesy of Fraunhofer IWU



REFCO

demonstrator

CASE 1 Joining of **compressed air dryer components**

- **Description of the product**

The product of the Refco case study is part of a refrigeration circuit of a compressed air-dryer. Compressed air dryers are devices for removing water vapour from compressed air and are used in a wide range of industrial products. The actual part is a Cu-tube brazed into a Ni-plated carbon-steel sleeve. This sleeve is fixed with a nut onto the refrigerant compressor or other components.

- **Current joining technology**

Currently, manual brazing with an acetylene torch is used to join the two components.



Cu-tube brazed onto a steel flange



Air dryer with the Cu connection tube



Components for joining by electromagnetic pulse welding



Whirlpool demonstrator

CASE 2 Joining of a **refrigerating circuit**

- **Description of the product**

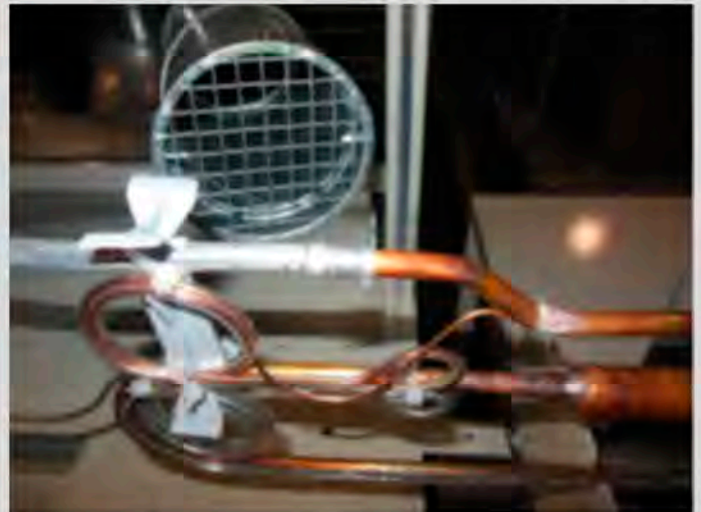
The product of the Whirlpool case study is the refrigerating circuit of a domestic refrigerator. The refrigerating circuit has the main function of transferring heat from the internal load of the refrigerator to the environment, in order to maintain food at a specific temperature. The refrigerating circuit is made of different pipes and components, amongst others aluminium-copper and aluminium-steel connections, that need to be joined together at different stages during the refrigerator assembly.

- **Current joining technology**

Currently, flame brazing is used most frequently, but in this technology the joint quality depends on the individual worker skills and it cannot be used in presence of flammable gases. Other technologies such as resistance butt welding and combined clinching and adhesive bonding are always chosen as a second choice, when brazing is not recommendable, but these are usually more expensive than flame brazing.



Refrigerating circuit of a domestic refrigerator



Close-up of the aluminium-copper connection within a domestic refrigerator

- **Advantages of Joining through EMW**

In both cases, electromagnetic pulse welding offers an alternative to brazing, as it is expected that it leads to a cost reduction due to the elimination of brazing filler materials and shortening of the production cycle. Moreover, improved joining quality due to increased automation and improved worker safety by eliminating hazardous substances, such as flame gas and brazing alloys, is expected.

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JOIN'EM

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FOR MORE INFO VISIT

www.join-em.eu

OR



Scan it here!

