INCD ISIM -TIMIȘOARA - 50 YEARS OF TRADITION IN WELDING AND MATERIAL TESTING

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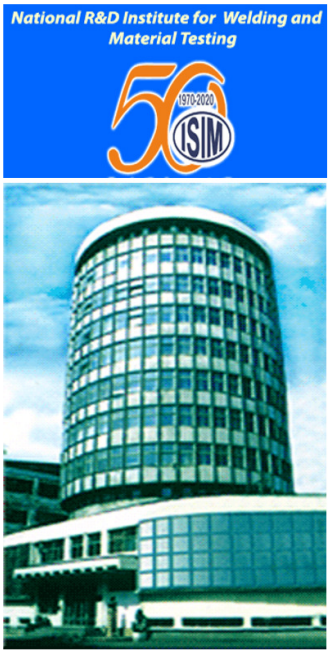
ABSTRACT: The paper presents aspects of the evolution of the National R&D Institute for Welding and Material Testing - ISIM Timisoara, from its establishment (1970) to the present, especially in the field of nonconventional technologies, development at the forefront in the same period. They are presented in summary events that have marked the history of 50 years and areas of attainment such as fundamental research in the field of phenomena related to welding and allied processes in material testing, applied research in the field of welding, related processes and most of the test material, nonconventional and hybrid welding processes, the welding and cutting processes with high productivity, the behavior of materials under severe mechanical and thermal stresses, as well as activities training and certification in welding and NDT. Greater emphasis in the field of nonconventional technologies is placed on research and development in the field of ultrasonic processing.
KEYWORDS: research and development institute, nonconventional technologies, ultrasound, welding.

1. INTRODUCTION

The National R&D Institute for Welding and Materials Testing - ISIM Timisoara, a scientific institution with national and international recognition, is Romania's representative at the International Welding Institute (IIW), having implemented the Quality Management System - ISO 9001/2015 for all its fields of activity, the TÜV SUD certified system, the ISO 14001/2015 environmental management system, the United Register of Systems (URS) certified system and the innovation management system according to the SR 13572: 2016 standard, the CIT IRECSON certified system. ISIM Timișoara is the founder and partner of the Romanian Welding Association (ASR) and a founding member of the Multidisciplinary Research Association of Western Romania (ACM-V).



ISIM Timisoara has gone through several stages in its development. Thus, during 1952-1954, within the Timișoara Base of the Academy of Sciences, the Welding Section and the Materials Resistance Section were established, led by acad. Corneliu MIKLOȘI (1887-1963) and acad. Ștefan NĂDĂȘAN (1901-1967), reference personalities of engineering sciences, for the history of the polytechnic school from Timișoara. The Technical Research Center of the Romanian Academy, which operates within the Timișoara base of the Academy, was elected as Romania's representative at the International Welding Institute (IIW), in 1957.


Acad. Corneliu Mikloşi

Another important stage in the history of the institute is represented by the establishment in Timișoara of the Welding and Fatigue Testing Center (CSIO), on February 09.1970, HCM 72-75, by merging the two existing sections within the Timișoara base of the Romanian Academy.


Acad. Ştefan Nădăşan

ISIM is thus the successor of the Romanian welding schools and the resistance of materials developed in Timișoara - a university center with a long tradition in scientific research, which has continuously developed its field of activity, obtaining remarkable performances in:

- fundamental and applied research in the field of material welding and allied processes, control and material testing, and welded structures;
- execution/development of new devices and equipment for welding, cutting, metallization, control and testing of materials;
- analyses and material testing services;
- coordination of work on standardization and elaboration of standards in the field of welding and

allied processes, nondestructive testing, and material mechanical testing;

- activities of scientific and engineering counseling, technical expertise, technological services;
- production of equipment and devices in the field, with new incorporated principles and solutions;
- production of welding materials;
- education and training of personnel at all levels;
- dissemination of scientific and technical information.

Acad. Traian Sălăgean

During 1970 and until now the position of general manager was occupied by Acad. Traian Sălăgean 1970-1982, dr.ing. Zeno Pircea 1982-1990, prof. dr.ing. Dragoș Cioclov 1990-1994, prof.dr.ing. Dorin Dehelean 1994-2011, dr.ing. Horia Florin Dașcău 01.2011-07.2011, dr.ing. Alin Constantin Murariu 2012-2016, dr. Ing. Nicușor-Alin Sîrbu 2011-2012/2016-present.

2. CURRENT DIRECTIONS OF RESEARCH AND DEVELOPMENT

Currently, ISIM Timisoara has two departments with responsibilities in the field of research and development, the research department being composed of two sections:

- department of joining processes and material testing;
- department of constructive development and production.

ISIM research objectives are focused on:

a. Main areas of research and development:

- fundamental research in the field of welding-related phenomena and related processes;
- fundamental research in the field of material testing;
- applied research in the field of welding, related processes and materials testing;
- welding with concentrated energy beams (laser, electron beam);
- welding by nonconventional and hybrid processes;
- high productivity welding and cutting processes;
- behavior of materials in severe conditions of mechanical and thermal stress;
- development of new materials by thermal spraying;
- assessment of remaining life of welded structures.

b. Secondary fields of research:

- bonding of metallic materials and composites;
- micro-joining of materials;
- behavior of amorphous materials;
- heat treatments of welded joints;
- testing of polymeric, composite and ceramic materials;
- design of welded structures.

c. Micro-production services:

- destructive / non-destructive material testing;
- metallographic analyzes;
- thermal fatigue of materials;
- technical diagnosis of thermo-mechanical required components;
- evaluation of the remaining life of industrial equipment;
- damage analysis;
- technological development: modernization/ automation of welding equipment, design of new welding equipment and material testing, production of prototype equipment;
- insurance consultancy and technical assistance in the implementation of modern methods of welding);
- training of qualified personnel in the field of welding and non-destructive examination;
- training and qualification of engineers, inspectors, skilled welders/International Europe;
- the qualification followed by the certification of END operators for non-destructive examinations, according to SR EN ISO 9712, certification by ISIM CERT END, accredited by RENAR, designated by MEC as a third part organization for the certification of personnel performing non-destructive examinations in the field of pressure vessels;
- qualification of operators in polyethylene welders according to EN 13067.
- certification: quality management system in welding according to EN ISO 3834 (companies from Romania, Germany, Moldova and Israel);
- certification of welders and operators' welders according to EN ISO 9606-1, EN ISO 9606-2, EN ISO 9606-3, EN ISO 9606-4 and SR EN ISO 14732;
- certification of welding / brazing according to the series of standards EN ISO 15614 and EN ISO 14555;
- inspections: determination of the remaining life of the components of energy and petrochemical equipment, of the manufacturing processes by welding and thermal spraying, respectively for product receptions.

3. RESEARCH ORIENTATION TO NONCONVENTIONAL TECHNOLOGIES

Research carried out in the institute was mainly applied type. A lot of activities consisted in solving Romanian industry needs, in specific areas.

A category of activities was the preparation, implementation and verification of novel technologies in terms of processes and materials.

An important aspect of the activity was and is represented by the collaboration with UPT teachers, there are areas approached with novelty, respectively that of unconventional technologies, activities carried out by the Romanian Association of Unconventional Technologies, which became a National Reference Center, with a decisive contribution was dr.ing. dr.doc.ş.t.dhc. Aurel Carol Nanu, (1921-2017) from UPT, respectively prof. Dr. Eng. Dumitru Mnerie, as a specialist in nonconventional welding technologies.

Thus, the ISIM Timişoara laboratories have developed, with multiple stages of modernization. They were carried out by self-endowment, or by various welding equipment purchase, installation of thermal spraying equipment ultrasonic welding, laser welding and cutting, materials testing machine, non-destructive examination equipment, etc.

Of nonconventional technologies applied to remark:

- processing with concentrated energy beams, especially welding with concentrated energy beams (laser);
- ultrasonic processing (welding, cutting, cavitation, etc.);
- friction stir processing (FSW);
- water jet and abrasive cutting.

The main research objectives of ISIM Timisoara are:

- processing with concentrated energy beams, especially welding and/or micro-welding with concentrated energy beams (laser, electron beam);
- welding by nonconventional and hybrid processes;
- water jet cutting of metallic and non-metallic materials;
- thermal cutting with plasma;
- ultrasonic processing;
- development of new materials by thermal spraying.

a) Concentrated energy beam processing laboratory

b) Laboratory of welding, cutting and heat treatment equipment

c) Ultrasonic processing laboratory

d) Plastics welding and testing laboratory

e) Surface Engineering and Thermal Spray Laboratory (HVOF)

f) Friction stir processing laboratory

Figure 1. ISIM Timisoara laboratories

Figure 2. Visits of personalities, researchers, teachers, students from the country and abroad, in the laboratories of ISIM Timisoara

In the institute, according to the strategy and organizational structure, laboratory tests, examinations and analyzes (LIEA) RENAR accredited laboratory which is authorized ISCIR and CNCAN functions.

In the institute there is a permanent concern to attract young students and graduates to research, to train as specialists. In this sense, ISIM Timisoara has permanently developed collaboration agreements with technical higher education institutions, also showing its readiness to support young human resources in order to complete bachelor's, dissertation or doctoral thesis with topics specific to the fields of activity.

4. DEVELOPMENT OF RESEARCH IN THE FIELD OF ULTRASOUND PROCESSING

Since the '80s, ISIM Timisoara's researchers had interests in the field of ultrasound. In the '90s ISIM Timisoara started reconfiguring its research space, shifting its research concerns to technology and equipment development in the active ultrasound field, namely welding, cutting and other form of processing.

Currently, ISIM Timisoara has competencies regarding ultrasound processing in the following directions:

- ultrasound welding/cutting technologies;
- technical and technological consultancy, technical support specialist in ultrasonic processing;
- education and personal development;
- specialized ultrasonic welding equipment, for concrete applications;
- execution of specific ultrasonic subassemblies for concrete applications;
- ultrasound welding/cutting services;
- supply of spare parts / wear parts (sonotrode);
- developing and optimizing ultrasound welding specifications of metallic materials as well as checking the quality of welded joints according to enforced standards and industrial requirements.

CEX-US project - ISIM Timisoara 2001- 2004 led to creation of the Center of Excellence in ultrasonic welding-oriented concerns:

- development of experimental logistics for high power ultrasonic equipment and apparatus 1500-3000 W;
- innovative development of control systems in programmable digital technology;
- sources modulated in PWM system;
- developing software for design sonotrode;
- experimental development of welding technologies for metallic materials and polymeric materials;
- developing partnerships with university research centers, companies and entities established in ultrasonic welding applications.

Among the Institute's activities in 2006-2008, noted the project „Virtual Center for Energy Technology Application Integrated with Electro-ultra-acoustic" in Advanced Materials Engineering, „Ultratech".

The project developed partnerships in the application of ultrasonic energy, logistics ISIM Timisoara (ultrasonic equipment developed in the project), Politehnica University Timisoara (shape memory materials, injection molding, extrusion assisted ultrasonic electronic interference equipment ultrasonic) with Timisoara Chemistry Center of the Romanian Academy (silica sono-gels, in ultrasonic regime), University Politechnica of Bucharest (nano-structuring intelligent composite materials in polymer matrix), INCEMC Timisoara Institute of Condensed Matter (hydrothermal processing with ultrasonic activation), University of Craiova (ultrasonic compacting of materials, powders).

The results of the activities carried out within the development programs of the technique and materials using ultrasonic energy led to collaborations with external partners (SLV Munich-Germany, GOSA Institut-Serbia and ICC Prod Câmpulung Moldovenesc).

The significant achievements of ISIM Timişoara regarding the evolution of ultrasonic technologies can be briefly presented, as follows:

- 90's - assimilation manufacturing equipment ultrasonic (US) 150-200W, 40kHz;
- 2000s - concerns for US high power equipment 1500-3000W:
  - innovative development of control systems in programmable digital technology, modulated sources in PWM system, development of software for sonotrode design;
  - development of high-power logistics 1500 / 3000W for the elaboration of experimental programs for processing metallic materials and polymeric materials;
- Virtual center for integrated technologies with applications of the electro-acoustic energy in advanced material engineering - ULTRATECH - ISIM Timisoara 2006-2008:
  - Specialized equipment for welding with ultrasounds ESUP - BEGA-01;
  - Specialized equipment for welding with ultrasounds ESUP ANA 01, 20kHz, 2500W;
  - ultrasonic joining of NiTiCu/Ni6Ti4V biocompatible alloy strips;
  - electro-ultra-sound calibration electrode sonotrode;

- micro-electro-erosion process-ability ultrasonic activation;
- cavitations erosion testing equipment micro-joining of non-ferrous materials by thermo-sonic processes;
- specialized equipment for ultrasonic welding of composite textile materials;
- sonotrode with interchangeable tips that have spatial arrangement designed and developed within PN16 08-102 project.

Ultrasonic horns (sonotrodes) are ultrasonic active tools used in technological applications that focuses and directs ultrasound in working areas.

Figure 3. Ultrasonic horns (sonotrodes) developed by ISIM Timisoara

Depending on the industrial or experimental application for which they are designed, they have a proper shape:

- sonotrode for ultrasonic processing - sonochemistry;
- sonotrode simulation using finite element specialized software;
- execution model according to dimensions.

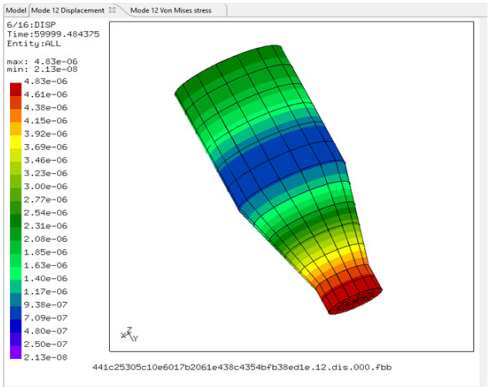


Figure 4. Sonotrode finite element simulation

Development of ultrasound processing equipment:

- Ultrasonic welding/cutting equipment for concrete applications;
- Specialized hybrid equipment for electric pressure and ultrasonic welding - ESEPUS 02 - The equipment is intended for the innovative development of new joining technologies; joining by hybrid electric process by pressure and / or ultrasonic of metallic materials with multiple applications in various fields of industry (example: electronics, electrical, automotive);

Figure 5. Specialized hybrid equipment for electric pressure and ultrasonic welding

- Ultrasonic welding equipment for metallic materials ESUM 03 - The equipment is designed to develop new innovative technologies for the ultrasonic joining of metallic materials with multiple applications in various fields of industry (electronics, electrical engineering, automobiles).

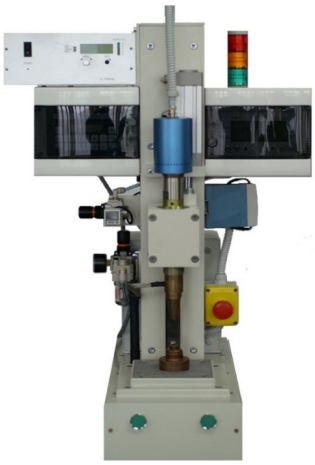


Figure 6. Ultrasonic welding equipment for metallic materials

Future concerns in the development of ultrasonic welding technologies at ISIM Timisoara:

I. Micro-joining of non-ferrous materials by thermo-sonic processes;
II. Ultrasonic joining of composite textiles;
III. Theoretical and experimental research on the effect of ultra-acoustic waves on the development of new welding processes and technologies.

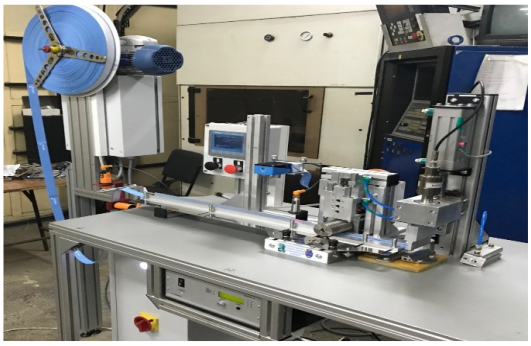


Figure 7. Hybrid equipment for cutting composite polymeric materials

5. VISIBILITY OF RESEARCH RESULTS

ISIM editing (four issues per year) scientific journal „BID - Welding and Material Testing" in a English version only. The journal includes, in addition to scientific papers developed in the institute, and works by authors from the country and abroad. The journal is rated B +.

ISIM has a standards library containing over 1,000 technical standards in the field of activity of ISIM. The scientific patrimony of the ISIM library contains a book fund of over 10,000 volumes / journals.

ISIM Timisoara continues to conduct extensive media campaign, especially through participation in scientific conferences, national and international trade fairs such as:

- European exhibition of creativity and innovation - EUROINVENT;
- International Exhibition of Inventions and Innovations „TRAIAN VUIA" Timisoara;
- ZR-BizNet Zrenjanin international fair;
- DEMO METAL VEST fair;
- European Researchers' Night;
- International fair of inventions scientific research and new technologies INVENTIKA;
- Various international and national conferences.

Figure 8. ISIM Timisoara attending invention fairs and exhibitions

For its activity, ISIM Timisoara obtained a series of awards.

Figure 9. Part of the awards won by ISIM Timişoara

6. ISIM'S DEVELOPMENTS FROM 1970 TILL PRESENT TIMES

Since its establishment, ISIM Timisoara has had as main objective the support of the main fields of activity/industry by obtaining, over the years, the results of valuable research, current at that time and their implementation in productive activities. Among the technological transfer achievements are mentioned:

- C. Miklosi designed and built a mobile installation (in situ) electric pressure for butt welding, with intermediate melting of the rails, under the name of „Taurus", the first of its kind in the world, it has been used since 1938; the installation is also patented in Switzerland;
- ISIM collective involvement in the rehabilitation and reintroduction in the safe operation of worn metal parts wear in urban rail transport (tram wheel rim, brake drums, axles, etc.) - reconditioning facility for mechanized MIG/MAG welding used components from public transport, type ISMU-0. They were conceived, designed, constructed and operated 4 machines mechanized/automated autonomous transport: Bucharest, Timisoara, Arad, Iasi;
- the institute designed 45 welding lines, which included 135 multi-point welding machines and 8 specialized presses equipped with spot welding equipment, within a program to modernize the manufacture of Dacia cars;
- realization in 2006 of mechanization/automation of the manufacturing process by MIG/MAG sidewalls of the freight wagons, the beneficiaries were Reva Simeria;
- in 2008, at Grivita Bucharest has launched into operation a computer control equipment for safety of freight wagons - ring bearing, conducted at ISIM Timisoara, intended for examination non-destructive of rings bearing rail during operations repair of passenger wagons;
- in 2018, ISIM Timisoara develops a hybrid equipment for cutting composite polymeric materials „EPU-PAS 1801", successfully used in the textile industry.

Among the latest innovative ideas developed at ISIM Timisoara are:

- CBI A00242/2019 - Ultrasonic processing center (Centru de prelucrare cu ultrasunete) - Nicușor-Alin Sîrbu, Victor Verbițchi;
- CBI A00792/2018 - Hybrid Equipment for Processing Polymer Composite Materials (Instalaţie pentru prelucrarea materialelor

polimerice compozite) - Octavian Victor Oancă, Nicușor-Alin Sîrbu, Gabriela-Victoria Mnerie, Emilia- Florina Binchiciu.

ISIM certified staff is part of the review teams of international journals and conferences (TIMA19, ICNcT, Journal of Materials Processing, MDPI, Materials, etc.). Also, some of the certified staff ensure the quality of editor, member of the scientific committee, editor and review in the journal BID-ISIM - Welding & Materials Testing, classified by the National Council of Scientific Research in Higher Education (CNCSIS) in category B + (CNCSIS code 549) starting with 2007 and respectively in the scientific committee of the journal of Unconventional Technologies, indexed BDI.

Following the evaluation performed in 2019, by the commission of evaluators, the Institute received the grade A, which is recognition of the activity carried out by ISIM Timisoara.

In 2021, ISIM Timișoara, will organize the 12th edition of the International Conference "Innovative Technologies for Joining Advanced Material", TIMA21, in collaboration with Politehnica Univerity Timisoara and Technical Sciences Academy of Romania - Timişoara Subsidiary, on November 25-26, in Timișoara.

7. REFERENCES

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