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The main project task was the preparation of a design handbook from the results data of the underlying projects, demonstrating the full potential of, and giving guidelines for, the application of safe and lightweight stainless steel structures in ground transport applications. The handbook was distributed, and is still available to the public free of charge in both paper and electronic forms.

The second major activity was arranging a series of six regional seminars with European-wide coverage once the manual was completed. The target groups covered the whole ground transport industry sector and service supply chain in Europe. After the seminars, a workshop on an invitation basis was arranged for reviewing the seminar feedback, establishing networking actions among the European players on the field, and composing future R & D initiatives.

The INSAPTRANS project as a whole was a success. All the major objectives were reached within the originally planned schedule and budget. The impression from the events was that the handbook was extremely well received by the participants. The positive attitude to the seminar arrangements and programmes could be seen especially in the feedback questionnaire results.

KI-NA-24218-EN-C

Price (excluding VAT) in Luxembourg: EUR 4

Publications Office

ISBN 978-92-79-13867-6

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European Commission

Research Fund for Coal and Steel

Innovative stainless steel applications in transport vehicles

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Contract No RFS2-CT-2007-00025
1 July 2007 to 31 December 2008

Final report

Directorate-General for Research

2010 EUR 24218 EN

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Luxembourg: Publications Office of the European Union, 2010

ISBN 978-92-79-14551-3

doi:10.2777/88587

ISSN 1018-5593

Printed in Luxembourg

PRINTED ON WHITE CHLORINE-FREE PAPER

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1. ABSTRACT

The main objective of the “Innovative stainless steel applications in transport vehicles” INSAPTRANS project was to disseminate the technical knowledge and application experience from two recently finished ECSC/RFCS funded research projects, “Stainless steels in bus constructions” (STAINLESS STEEL BUS) and “Development of lightweight train and metro cars by using ultra high strength stainless steels” (DOLTRAC).

The main project objective was the preparation of a design handbook from the result data of the underlying projects, demonstrating the full potential of and giving guidelines for the application of safe and lightweight stainless steel structures in ground transport applications. The handbook was distributed, and is still available to the public free of charge in both paper and electronic forms.

Second major objective was to arrange a series of six regional seminars with European wide coverage once the manual was completed. The target groups covered the whole ground transport industry sector and service supply chain in Europe. After the seminars, a workshop on invitation basis was arranged for reviewing the seminar feedback, establishing networking actions among the European players on the field, and to compose and evolve future R&D initiatives.

The INSAPTRANS project as a whole was a successful one. All the major objectives were reached within the originally planned schedule and budget. The impression from the seminars was that the receiving of the handbook was extremely positive among participants. The positive attitude to the seminar arrangements and programmes can be seen especially in the feedback questionnaire results.

2. FINAL SUMMARY

This report summarises the actions taken and results achieved in the RFCS project *"Innovative stainless steel applications in transport vehicles"* (INSAPTRANS: contract RFS2-CT-2007-00025). INSAPTRANS was a Type 2 project, i.e. its main function was not to produce new research results, but to disseminate the result data of two earlier research projects. Hence also the relatively short duration of 18 months, which resulted in extremely intensive project work, especially during the last six-month period.

2.1. INTRODUCTION AND PROJECT PARTNERS

The main objective of the INSAPTRANS project was to disseminate the technical knowledge and application experience resulting from two recently finished ECSC/RFCS research projects, namely "Stainless steels in bus constructions" (STAINLESS STEEL BUS: contract 7210-PR-176), and "Development of lightweight train and metro cars by using ultra high strength stainless steels" (DOLTRAC: contract 7210-PR-363). The primary tool for realising this dissemination task was the compilation of a handbook on advanced lightweight stainless steel structures in ground transport vehicles. It summarises the vast amount of result data that was generated and reported in the above research projects. Following the printed version, the handbook was also made available in electronic format.

The dissemination function of the handbook was supported by a series of six regional seminars across the European Union. Furthermore, a workshop followed the seminars for reviewing the seminar feedback and establishing networking actions among the European industrial, research and academic players on the field. Another aim of the workshop was to compose and evolve future R&D initiatives in the area.

The project consortium consisted mainly of partners involved in the original research projects. In addition to project partners, Helsinki University of Technology carried out remarkable work especially in WP2 as a sub-contractor to Outokumpu (5). The INSAPTRANS partners were the following:

Contractor 1: VTT Technical Research Centre of Finland (co-ordinator)
VTT Technical Research Centre of Finland is an impartial expert organisation. Its objective is to develop new technologies, create new innovations and value added thus increasing clients' competitiveness and competencies. VTT produces research, development, testing and information services to public sector and companies as well as international organisations.

With its staff of 2800 experts VTT provides high-end technology solutions and innovation services. From its wide knowledge base, VTT can combine different technologies, create new innovations and a substantial range of world class technologies and applied research services. Through its international scientific and technology network, VTT can produce information, upgrade technology knowledge, create business intelligence and value added to its stakeholders.

Contractor 2: OCAS N.V.
OCAS is one of the two research laboratories located in Belgium for the domain "Industry" of the ArcelorMittal Group. The research centre is located close to the ArcelorMittal Gent production facility. OCAS was founded in 1988, and the laboratory was opened in September 1991. OCAS has more than 100 employees (from 10 different countries) of which more than 2/3 has a university degree. The research areas cover various types of steel substrates used for non-automotive applications, such as electrical steels, steels for tubes and pipes, enamelling steels and stainless steels.

The most sophisticated equipment is available to characterise the physical, chemical and electrochemical properties, the mechanical properties and the microstructural features of processed steels. Further, OCAS has a broad experience in organic, metallic and enamelled coatings. An extended coating laboratory is available for application and quality testing of the various types of coatings.

Contractor 3: Centro Sviluppo Materiali (CSM) S.p.A.
CSM is a leading centre for applied research with extensive experiences on the steel innovation, FEM numerical simulation and forming techniques. The Centro Sviluppo Materiali (Material Research Centre) was founded in 1963 in reply to the Italian Steel Making and Steel Using Industries' request. The purpose of CSM is to carry out research on science and technology, and to promote industrial activities in the field of material innovation and know-how development for the steel industry and for other high technology industries.

CSM is also involved in technology transfer operations, consisting mainly of the design and development of innovative pilot plants and software prototype developing, improving production, reducing environmental impact and developing materials and products. CSM carries out research and development in close collaboration with the Government, European and International agencies, industries, universities and other supporting institutions.

Contractor 4: Euro Inox ASBL
Founded in its present structure in 1999, Euro Inox is the European market development association for Stainless Steel. The members of Euro Inox include European stainless steel producers, national stainless steel development associations and development associations of the alloying element industries. A prime objective of Euro Inox is to create awareness of the unique properties of stainless steels and to further their use in existing applications and in new markets. To assist this purpose, Euro Inox organises conferences and seminars, and issues guidance in printed form, and electronic format, to enable designers, specifiers, fabricators, and end users, to become more familiar with the material. Euro Inox also supports technical and market research.

Contractor 5: Outokumpu Stainless Oy
Outokumpu Oyj is an international stainless steel company operating in some 30 countries and employs 8 500 people. The group´s headquarters are located in Espoo, Finland. Stainless steel production exists in Finland, Sweden, UK and in the US having a wide range of stainless steel products including hot and cold rolled, precision strip, tubular and long products together with a comprehensive range of fittings, flanges and welding consumables. Customers are in a wide range of industries ranging from the process industry and industrial machinery to building, construction and electrical industry, transportation, electronics and information technology, as well as catering and households industries.

Tornio Research Centre (TRC) is locating in a heart of Outokumpu Tornio Works, which consist of an integrated stainless steel manufacturing process from mine to finished stainless steel flat products. Latest production technology brings an advantage when new process routes and products are developed. TRC employs 130 persons and it is one of the two main research units in Outokumpu.

Contractor 6: Acerinox S.A.
Since it was founded in 1971, Acerinox has launched into operation one of the most complete and up-to-date industrial works in the world for stainless steel products. Palmones works has become one of the few integrated facilities of this speciality. At present Acerinox is one of the most important flat product stainless steel manufacturer with a melting shop production of some 2.2 million tons in 2005 and a staff of 6695 employees, distributed among the Spanish, American and South African plants.

In the Palmones – Los Barrios factory, there are currently 2400 employees, 60 of whom belong to the R&D Laboratories, including almost 40 university graduates. The company follows policy of continuous improvement in its production facilities, supported by the development of new and improved steels and applications by the R&D group, within European and Spanish research project frameworks.

Contractor 7: Ugine & ALZ Belgium N.V., currently ArcelorMittal Stainless Europe
ArcelorMittal Stainless Europe represents group´s European companies producing flat stainless steel products. AMSE employs more than 5000 people all over Europe. A great majority of the more than 1 million tonne annual production is sold in Europe. The group consists of four mills (France and Belgium) and eight service centres with sales offices in all major European countries.

AMSE produces a complete range of products for the main stainless steel markets (household, automotive, industry, building). Other business units producing stainless steel products are located in Europe (tubes, long products, special alloys, precision rolled products, quarto plates) and Brasil (flat products). AMSE has a research centre dedicated to stainless steel, located in Isbergues, France employing 60 people.

2.2. PROJECT OBJECTIVES

The main objective of the INSAPTRANS project was to disseminate the technical knowledge and application experience from two recently finished ECSC/RFCS funded research projects, namely "Stainless steels in bus constructions" (STAINLESS STEEL BUS) and "Development of lightweight train and metro cars by using ultra high strength stainless steels" (DOLTRAC). The primary tool for realising this task was the compilation of a handbook on advanced lightweight stainless steel structures in ground transport vehicles. More specifically, the originally planned ways and means were:

- Preparation of a design manual from the result data of the two above projects, showing the full potential of and giving guidelines for the application of safe and lightweight stainless steel structures in ground transport applications. All the relevant aspects for the realisation of such structures were to be covered, e.g. materials, joining, forming, mechanical testing, crash experiments and simulation and corrosion, as well as design. A special emphasis was put on the product life cycle cost and environmental impact effects. The manual has been distributed European wide in both paper and electronic forms.
- Supplementing the base ECSC/RFCS project data with the latest state-of-the-art from relevant national and European projects. Although both the original projects have been finished recently, related public research work has been carried out in other programmes in Europe as well. Reviewing these results will increase the coverage and value of the manual. Some demonstration LCC calculations based on the projects´ result data were carried out and used as examples in the handbook as well.
- Arranging a series of regional seminars European wide coverage once the manual has been completed. The target groups cover the whole ground transport industry sector (passenger, freight, special vehicle) and service supply chain (train and metro cars, road vehicle chassis and powertrain, body, end users) in Europe. National stainless steel development associations, working together with Euro Inox, were involved to assist in the seminar arrangements and marketing. Following the seminars, a workshop on invitation basis was arranged for reviewing the seminar feedback and establishing networking actions among the European industrial, research and academic players on the field to compose and evolve future R&D initiatives on the area.

2.3. COMPARISON BETWEEN PLANNED AND ACCOMPLISHED WORK

When reviewing the work accomplished during the project to the work plan and objectives indicated in the original proposal, it can be said that all the major goals were reached in INSAPTRANS. The tight project schedule caused some heavy pressure for the consortium in the realising of especially WP3 "Revision and publication" of the handbook paper version. Still, the handbook was available for distribution from the very first seminar, as originally planned. The schedule did, however, reduce the timeframe available for the final graphics design, which in turn reflected in the cost as well.

Another effect of the short time frame available was probably the number of workshop participants that remained below to what was anticipated. A longer interval between the seminars and workshop would probably have been beneficial. On the other hand, one must not neglect the effect of abruptly changing economic situation towards the end of 2008 on the ability and willingness for prime cost travelling to such an occasion either.

2.4. DESCRIPTION OF ACTIVITIES AND DISCUSSION

In the following, only a brief summary of the activities and deliverables will be done on task-by-task basis. More exhaustive descriptions can be found in later parts of this report.

Handbook manuscript preparation (WP1)
The main handbook target group was identified as designers that should be made aware of the possibilities that the new stainless alloy developments on one hand, and the advanced modern manufacturing methods on the other, offer in transport vehicle constructions. The most essential mission of the handbook was defined as the ability to summarise the large amount of project data in a condensed form for the target group to adopt.

Bearing these facts in mind, the preparation of the manuscript for the handbook on the application of advanced lightweight stainless steel structures in ground transport vehicles was started by gathering the background data, i.e. the original project results from the STAINLESS STEEL BUS and DOLTRAC projects. In the first phase this included only the material of the project final reports, but later on more detailed result data were made available by the original partners as well.

Responsible partners were named for each handbook chapter that led the first draft manuscript preparation and asked for contribution from other partners involved. The mainline was that the partners´ contributions concentrated on topics they were involved in the original projects, i.e. on their core expertise areas. However, comments were naturally given on other areas as well. The final deliverable was a draft manuscript – including the WP2 supplement data – that was forwarded to further processing in WP3 that eventually resulted in the final 125 page paper copy handbook.

Project data supplement (WP2)
The activities to update and supplement the underlying project data with the most recent published results were launched parallel to the original data processing of WP1. Special emphasis was put on novel steel grades and conditions for transport solutions, requirements and standards needed by ground transport manufacturers, life cycle cost (LCC) analyses and fire resistance advantages of stainless steel, especially as compared to aluminium.

Simultaneously, the work on the new LCC/LCA calculations based on the latest LCI data was carried out by the subcontractor HUT supported by Outokumpu, VTT and CSM experts. The revised calculation and other life cycle related work was edited and included in the handbook manuscript in WP1 according to the original project plan and schedule. CSM produced an exhaustive compilation of the existing relevant stainless steel product standards with their latest version updates. The compilation was used as the base for further editing work and was eventually adopted into the manuscript and further into the handbook.

Several ongoing or recently finished projects were identified in both national and EU research programmes that provided the handbook with valuable supplementary data, although with some limitations with respect to publicity. Valuable data was adopted on, e.g. the fire resistance of stainless steel. Furthermore, some additional proprietary data was also identified by producers that was processed for inclusion in the handbook.

Manuscript revision and handbook publication (WP3)
Following the final manuscript editing, the content of the handbook was reviewed by all project partners for final approval. An additional grammar and style check was carried out for the manuscript by a native English speaking professional. In this way the readability was improved, too. Euro Inox provided expertise for the printing of the handbook. Because of time constraints, the production of the printing files could not be left to a graphic design house, as originally planned. Instead, it was performed in-house by Euro Inox. The handbook was also converted into a CD-ROM that can be downloaded or requested as a physical copy from Euro Inox website. In addition to the text identical to that in the paper version of the handbook, the seminar and workshop presentations are also included in the electronic version.

A uniform project graphic scene was prepared by a professional graphic designer for the handbook and other communication activities. This included the cover design of the printed and CD versions of the handbook, project letterhead and presentation templates for the seminar marketing and presentation preparation in WP4.

The dissemination of the printed handbook was carried out by Euro Inox. A copy of the handbook was handed out to all seminar participants. Additionally, a database with contact information of relevant people in transport industry was constructed and a campaign was carried out marketing the seminars and announcing the availability of the handbook from Euro Inox free of charge. By the end of the project, more than 1 000 copies of the handbook were disseminated European wide. As free copies are still available through Euro Inox website, the process is ongoing, although the project is finished.

Regional dissemination seminars (WP4)

The main purpose of the seminars was obviously to disseminate knowledge on the use of stainless steels in transport applications, but they were also seen as very important occasions and opportunities to create and gather new ideas and contacts. The division of responsibilities in seminar arrangements was agreed upon already during the project kick-off together with the provisional locations and schedules. Only minor adjustments were made later on to improve the coverage. The seminars were tailored according to local needs and audiences. This meant that there was only one "compulsory" presentation dealing with the project and handbook, and the invitation of local speakers was encouraged. All the six seminars were held during an intensive three weeks´ period from late September to mid-October.

The seminars were marketed with a press release that was sent out by Euro Inox to more than 70 publishing houses and also displayed on the Euro Inox web site. Additionally, circular letters were used for promotion together with additional communicative efforts, e.g. press releases and web news page entries, by the INSAPTRANS partners and the national stainless steel development organisations.

The gathering of feedback from all the six seminars was seen extremely important. A short and compact questionnaire similar in contents and exterior was prepared and used for each seminar to collect commensurate feedback. In some cases the forms were translated into the local language to avoid ambiguity. Based on the questionnaire results, the seminar series was successful from the audience point of view. From organisers´ angle, the number of participants in some seminars might have been higher, but the overall result was more than satisfactory. Noteworthy is, that three of the seminars – Germany, France and Poland – were also subjects of subsequent national magazine articles that improved the media visibility of the project considerably.

R&D networking and foresight workshop (WP5)

The workshop date was to be fixed earliest possible to be able to invite the appropriate participants in due time. The workshop was arranged on an invitation basis. All the partners delivered their proposals for workshop participants to CSM that were complemented with the people who had expressed their interest in workshop attendance in the seminars. This resulted in an invitation list of almost 100 names.

The workshop programme was constructed to allow time for discussion among the participants. Three major topics were selected for keynote addresses, each followed by a discussion. A summary of the workshop was prepared for the final discussion. Some of the topics rose in the final discussion – part of them originating from the seminar feedback – were:

- More studies needed on crashworthiness of materials (and structures)
- Need for prefabricated stainless steel components, e.g. rolled or extruded profiles, their properties
- Fire safety: shielding of critical components, e.g. fuel tanks, fire resistance of lightweight structures, simulations and testing of fire safety, e.g. in tunnel fire
- Mechanical joining and adhesive bonding of stainless steels, dissimilar material welds
- Design of welded details for fatigue: large scale testing, spot welded structures, etc.
- Spatial analysis for sandwich constructions (torsion and stability)
- Repairability of the new lightweight stainless structures

It was noticed in the meeting that the number of participants was disappointing. The abrupt change in the economical situation may have contributed in this, but also the time gap between the seminars and the workshop may have been too short – a couple of months´ maturing time might have produced different results from the workshop point of view. On the other hand, the total time available for this type of dissemination project was also limited. Still, it can be concluded that the level of discussion in the

workshop was high enough to at least partially compensate for the small number of It can be summarised from attendees.

2.5. SUGGESTIONS FOR FUTURE SEMINARS AND PROJECTS

Seminar – or workshop – advance marketing for focused target groups well in advance is vital for the arrangement of a successful event. To accomplish this, effective utilisation of local players, e.g. trade associations, market development organisations and producers´ own marketing organisation provide a tool that should be taken advantage of. This was done also in INSAPTRANS but the marketing efforts should have been earlier and better focused.

The optimal duration of seminars would probably be ½ to ¾ days, because a full day may restrict the participation from a distance. To make the events more attractive, some kind of small scale foyer exhibition with physical examples of novel structural solutions and other research results available, combined to a small session of research project posters might be appropriate. However, care should be taken on "neutrality" of such side events: the new developments should not be too obviously labelled to only one producer or brand, but be rather presented by, e.g. research organisations.

For similar type of projects, the scheduling is critical. Even if extended by 50% like in the case of INSAPTRANS, the RFCS set maximum duration of 12 months for a Type 2 dissemination project is extremely short. This means the project activities must be launched, i.e. the project kick-off should take place as early as possible. In this respect, midsummer is not the best possible slot for the project launch. An earlier kick-off in, e.g. March – April, or a later one in September – October might be more efficient: the project start would be more intensive and the partners could perform their own tasks and responsibilities independently over, e.g. longer holiday seasons.

As for the project consortium, the presence of several major steel producers is definitively a great benefit. Furthermore, the participation of a partner specialised in publication and promotion, in this case Euro Inox, was an enormous advantage for a project with publications and public events as major deliverables. These areas are typically not the strongest expertise of research organisations.

2.6. CONCLUSIONS

It can be summarised from the above short description of activities that the INSAPTRANS project as a whole was a successful one. All the major objectives were reached within the originally planned schedule and budget. However, the challenges introduced by the tight project schedule were further emphasised by the holiday season preceding the six seminars and the workshop. In practise this meant that the overall time frame was perhaps too narrow to accommodate all these events. The consortium felt that especially the degree of workshop attendance suffered from this.

The final physical deliverables, i.e. the handbook and the CD-ROM were produced in time to be used both during the project and to be kept available after its closure. Because the participants only received their handbook copies in the beginning of a seminar, and had thus no time to get properly acquainted with it, no feedback was asked for either. Still, the impression among the consortium members in the seminars was that the receiving among participants was extremely positive.

The positive attitude to the seminar arrangements and programme can be most clearly seen in the feedback questionnaire results. The average of all marks given on a scale on 1 to 5 was 3.7, which has to be considered as an extremely satisfactory result. Furthermore, the activity of the audiences in the form of questions and discussions revealed that the subject was regarded both very interesting and important. The media visibility of the project in conjunction of three seminars is also noteworthy.

3. DESCRIPTION OF RESULTS

3.1. WP1 – HANDBOOK PREPARATION: leader VTT (1)

3.1.1. OBJECTIVE

- Preparation of the manuscript for the ***handbook on application of advanced lightweight stainless steel structures in ground transport vehicles***

3.1.2. ACTIVITIES

The preparation of the manuscript for the handbook on the application of advanced lightweight stainless steel structures in ground transport vehicles in WP1 was started by gathering the background data, i.e. the original result data from the STAINLESS STEEL BUS and DOLTRAC projects. In the first phase this included only the material of the project final reports, but later on task and intermediate reports and other more detailed result data were made available as well.

An outline for the handbook construction was created for and edited in the kick-off meeting. A preliminary structure as well as a draft table of contents were agreed upon to be used as a basis for the manuscript. Furthermore, responsible partners were named for each handbook chapter that led the first draft manuscript preparation and asked for contribution from other partners involved. The mainline was that the partners´ contributions concentrated on topics they were involved in the original STAINLESS STEEL BUS and DOLTRAC projects, i.e. on their core expertise areas. However, comments were naturally encouraged to other areas as well.

Practical arrangements were also required to facilitate efficient processing of the large selection of source data. One of the most important ones was establishing an interactive environment for manuscript editing with sufficient version control. The VTT document handling system that may be set to enable restricted access from outside VTT as well, was selected for a processing platform. All the original data was uploaded in the system and thus made available for all the partners for reviewing and editing. Furthermore, a common document template was prepared by the WP leader to be used in the manuscript construction.

The focus and emphasis of the handbook were discussed intensively in the project kick-off. It was concluded that the main target group was designers, who were to be made aware of the possibilities that the new stainless alloy developments on one hand, and the advanced modern manufacturing methods on the other, offer in transport vehicle constructions. Once the designer realises the potential, he needs to be provided with the relevant cost and especially life cycle data to justify the use of stainless from both technical and economical viewpoints in practical transport applications.

The most essential mission of the handbook was defined as the ability to summarise the large amount of project data in a condensed form for the target group to adopt. Thus, care was to be taken when deciding what to include in the handbook and what to leave out – and also when preparing appropriate references to the project reports and other original data for those wishing to deepen their knowledge.

All partners had their own responsible areas that they had been concentrating in during the original projects. For practical reasons, i.e. in order to have the printed handbook ready for distribution during the local seminars, a deadline for the manuscript was set to allow enough time for final editing, graphic layout, language check, etc. Reaching this goal required two technical meetings that were not anticipated in the original project proposal.

The final deliverable of this work package was a draft manuscript – including the WP2 supplement data – that was forwarded to further processing in WP3 that eventually resulted in the final 125 page paper copy handbook. An overview of the contents can be found in the following Table 1.

Table 1. The table of contents of the final handbook manuscript.

1	**Introduction: Stainless steels in transport vehicles**
1.1	Rail applications history
1.2	Current rail applications
1.3	Bus and coach applications
1.4	Future potential
2	**Materials**
2.1	Material grades
2.2	Delivery conditions
2.3	Mechanical behaviour and design values of properties - Project material tensile properties, Design values and physical properties of stainless steels
2.4	Anisotropy of cold formed stainless steel materials
2.5	Corrosion properties - Atmospheric corrosion, De-icing and dust control chemicals, Corrosion resistance evaluation, Corrosion test results, Corrosion test summary
2.6	Stainless steel high temperature mechanical properties: fire resistance
2.7	Selection of materials - Structural applications, Forming applications, Summary
3	**Lightweight structures and design**
3.1	Stainless hollow section structures - Manufacture of hollow sections, Structural design aspects for hollow section joints
3.2	Sandwich panel structures - Design principles of sandwich panels, Panel cross section, Elastic response, Strength and deflection criteria, Structural optimisation, Design tools, Special issues in all-steel sandwich panel design
4	**Manufacturing issues in lightweight structures**
4.1	Bending of high strength stainless steel sheets - Verification of minimum sheet bending radius, Determination of sheet springback behaviour, Guidelines for bending ultra high-strength stainless steel
4.2	Tube bending - Types of mechanical tube bending processes, Springback model, Rectangular tube bending results, Design guidance for three-roll tube bending
4.3	Welding and joining - Arc based welding processes, Laser based welding processes, Resistance welding, Adhesive bonding
5	**Properties of lightweight structures**
5.1	Welded joint properties - Static strength, Fatigue and corrosion fatigue strength
5.2	Sandwich panel mechanical properties - Four-point bend testing of full-size panels, Three point bend testing of panel sections, Summary and conclusions
5.3	Lightweight structure crash properties - Side impact tests, Tubular frame crash tests, Panel compression and crash testing
6	**Life cycle issues**
6.1	Effect of vehicle weight on life cycle cost
6.2	Environmental effects of bus-frame materials
6.3	Life cycle cost evaluation of bus-frame materials
6.4	Summary
7	**Summary**

3.2. WP2 – SUPPLEMENT DATA: leader OCAS (2)

3.2.1. OBJECTIVES

- Supplementing the base ECSC/RFCS project data with the latest state-of-the-art from relevant projects
- Related public research work carried out both on national and European level
- Demonstration LCC calculations based on the projects´ result data to be used as examples in handbook
  → Increase of the coverage and thus value and substance of the manual

However, during the execution of the project the activities with respect to materials development were focused more in detail on two issues: (i) novel stainless grades for material cost reduction and stabilisation, and (ii) on the extended delivery condition range, i.e. high degree of cold forming resulting in enhanced mechanical properties.

3.2.2. ACTIVITIES

Parallel to the collection, condensation and editing of the background result data from the STAINLESS STEEL BUS and DOLTRAC projects in WP1, activities were also launched to update and supplement the data with the most recent published results. Simultaneously, the work on the new LCC/LCA calculations based on the latest LCI data was carried out by the subcontractor HUT supported by Outokumpu, VTT and CSM.

The aims for collecting supplement, state-of-the-art data were specially focused on four topics:

1. Novel steel grades and conditions offered by the steel producers for transport solutions;
2. Requirements and standards requested by ground transport manufacturers;
3. Fire resistance of stainless steel, especially as compared to aluminium, and
4. Life cycle cost (LCC) analyses

Because most of the data collected was included in the handbook manuscript and can be reviewed in the final handbook, the contents and results of respective tasks will be surveyed only shortly in the following. Instead, the emphasis is put on two issues that were raised in the project preparation and negotiation phases, namely demonstration LCC calculations with updated LCI data, and the fire resistance comparison between stainless steel and aluminium.

3.2.3. TASK 2.1: REVIEW OF STANDARDS AND TECHNICAL SPECS

CSM produced an exhaustive compilation table to review and compare the relevant existing stainless steel product standards with their latest version updates. The compilation table was used as the base for further editing work, as well as complemented with stainless steel application data originating from recently published work, see also Task 2.3, to enable eventual adoption into the manuscript and further into the handbook.

3.2.4. TASK 2.2: RECENT PUBLIC NATIONAL AND EUROPEAN PROJECTS

Several ongoing or recently finished projects were identified in both national and EU research programmes that provided the handbook with valuable supplementary data, e.g. “Stainless steel in fire” (RFCS), “Weight reduction for safer, affordable passenger cars by using extra formable high strength austenitic steel” (FP5) and “New stainless steel applications in transport and process equipment industries” (Finnish Funding Agency for Technology and Innovation). The available result data was investigated with respect to the degree of publicity and conformity and was used to supplement the original project data where appropriate and applicable. The original sources are being referred to in the final handbook for easy access to more exhaustive data. As mentioned earlier, the fire resistance properties will be reviewed briefly later on.

3.2.5. TASK 2.3: STEEL PRODUCERS´ OWN DATA

A major share of the steel producers´ data has been generated in projects that were reviewed in Task 2.2 and were thus also subject to possible publicity restrictions relevant to a particular project. However,

some additional proprietary data was also identified by producers and was processed for inclusion in the handbook.

3.2.6. TASK 2.4: DEMONSTRATIVE LCC CALCULATIONS

Outokumpu provided their sub-contractor HUT with supplementary data especially on the Life Cycle Inventories (LCI) of stainless steel. The revision and updating work of the original project calculations was carried out by HUT in co-operation with VTT experts. CSM provided support for this work based on their STAINLESS STEEL BUS contribution. Unfortunately, the update work on LCI that was scheduled to be available in time for the handbook was delayed, thus the 2008 updated data could not be utilised. The revised calculation and other life cycle related work was also edited and included in the handbook manuscript in WP1 according to the original project plan and schedule.

3.2.7. FIRE RESISTANCE OF STAINLESS STEEL

The stress-strain relationships of stainless steels as a function of temperature must be understood in order to determine the load-bearing capacity of a structure under fire conditions. Tests to determine mechanical properties at elevated temperatures are classed as “steady-state” and “transient-state”. In the traditionally used steady-state tests, the temperature is kept constant, while in transient-state tests it is the load that remains unchanged. The transient-state test is claimed to give a more realistic description of a material’s behaviour in fire conditions. The difference between the stress values established using different test methods depends on the temperature considered. When comparing the results of cold-formed materials, it is important to pay attention to the fact that the degree of material deformation (i.e. the strength level of a cold-worked material) also affects the behaviour at elevated temperatures.

Figure 1 demonstrates the difference between the fire behaviour of different austenitic stainless steel delivery conditions, stainless steel types and stainless and aluminium alloys. The stainless steel curves are based on established reduction factors that can be found in, e.g. (Euro Inox 2006), and the project material data except for Type 1.4318 2B, for which EN 10088-2 values are used. Aluminium alloy data is from Aluminium Taschenbuch (1988).

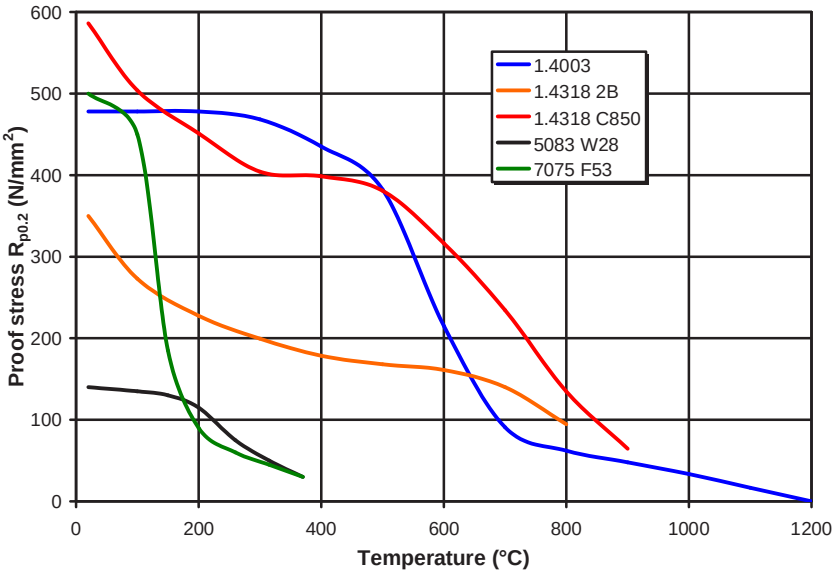

Figure 1. Proof stress temperature-dependency of various stainless steels and aluminium.

It is typical of cold-worked stainless steels that the strength difference resulting from cold working remains up to about 600 °C, but it decreases rapidly beyond that point, so that there is virtually no strength advantage left at 900 °C. The ferritic 1.4003 grade retains its room-temperature strength up to 500 °C but the strength drops sharply below the level of austenitic stainless steel grades at around 600 °C. For the aluminium alloys, the collapse in strength values occurs at considerably lower temperatures than in the case of stainless steels. This is understandable, considering the low melting temperatures of these alloys, below 600 °C. There are no significant differences between the AlZnMgCu alloy EN-AW

7075 and the lower-alloyed AlMgMn alloy EN-AW 5083, despite the fact that the former has considerably higher room-temperature strength.

3.2.8. LIFE CYCLE COSTS

It has been shown in the INSAPTRANS handbook that the use phase is dominating the greenhouse gas emissions of buses and coaches by more than 90% share (Sirén et al. 2008). Vehicle weight, on the other hand, has a fundamental effect on fuel consumption. A recent Finnish study suggests that vehicle weight reduction and the development of aerodynamic performance could lower airborne emissions of heavy road traffic by 30 % (Nylund 2006). This underlines the need for new innovative ways to reduce curb weight of heavy vehicles. Lower weight means also reduced material use and thus lower environmental impact. In other words, reducing empty weight could directly increase the payload weight fraction in commercial road traffic, which would improve both the economic and environmental performance of freight transport. Figure 2 shows how vehicle weight affects the fuel consumption of heavy vehicles.

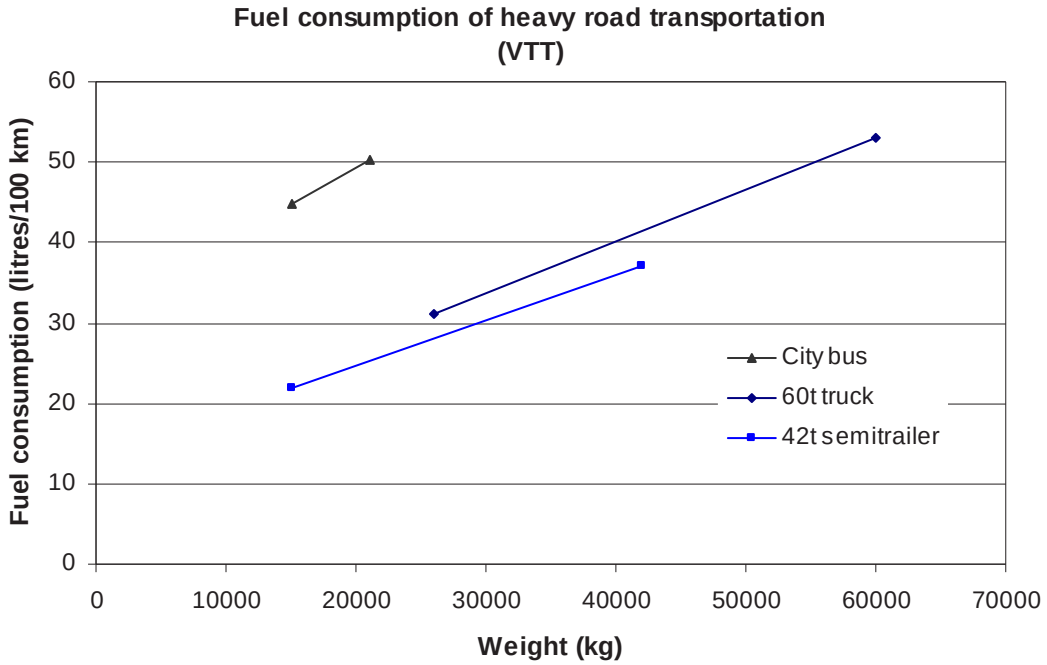

Figure 2. Fuel consumption and weight relationship of heavy road traffic (Nylund 2006, Mäkelä 2008).

While steels have long been the dominant structural materials for the transportation industry, over the years, the industry has sought alternative means and materials to improve the performance of vehicles. Structural solutions using different materials vary in their weight, material production and recycling. It is therefore clear that a comprehensive life cycle perspective is needed when considering the environmental performance of vehicles. Long product life cycle, in terms of years and kilometres, differentiates commercial vehicles from private cars. Heavy transportation therefore requires individual analyses that take all the life cycle stages into account, from raw material production to the end of life.

The latest developments in stainless steels resulting in higher material strength cannot always be utilised directly in transport vehicle structures because the design of especially body and frame structures is based on stiffness and/or fatigue rather than on static strength. However, the utilisation of the excellent formability of austenitic stainless grades, combined with the use of latest high strength materials and manufacturing technology developments, enables the use of formed sheet metal parts or profiles that combine the high material strength with stiffness gained through geometrical characteristics rather than the amount of material, i.e. thickness. This may result in considerable weight savings in transport equipment structures in the first place, further into reduced fuel consumption, and finally into lowered life cycle costs. Exam-

ples of such novel structural solutions are being represented in the INSAPTRANS handbook (Sirén et al. 2008).

Even a small reduction in the weight of bus components can offset high initial material costs by lowering life cycle cost. Figure 3 shows a weight-saving target with an original frame weight of 1 200 kg and an alternative material that is 1 €/kg more expensive. With an annual driving distance of 100 000 km and a 15-year operating life, life cycle costs are lower with less than 4% weight reduction. This is achieved by fuel savings alone, even without any additional cost-saving associated with lower manufacturing or maintenance costs. It should be remembered that the good corrosion resistance of stainless steel can also lower lifetime costs per kilometre, by extending operating lifetime and/or reducing maintenance costs.

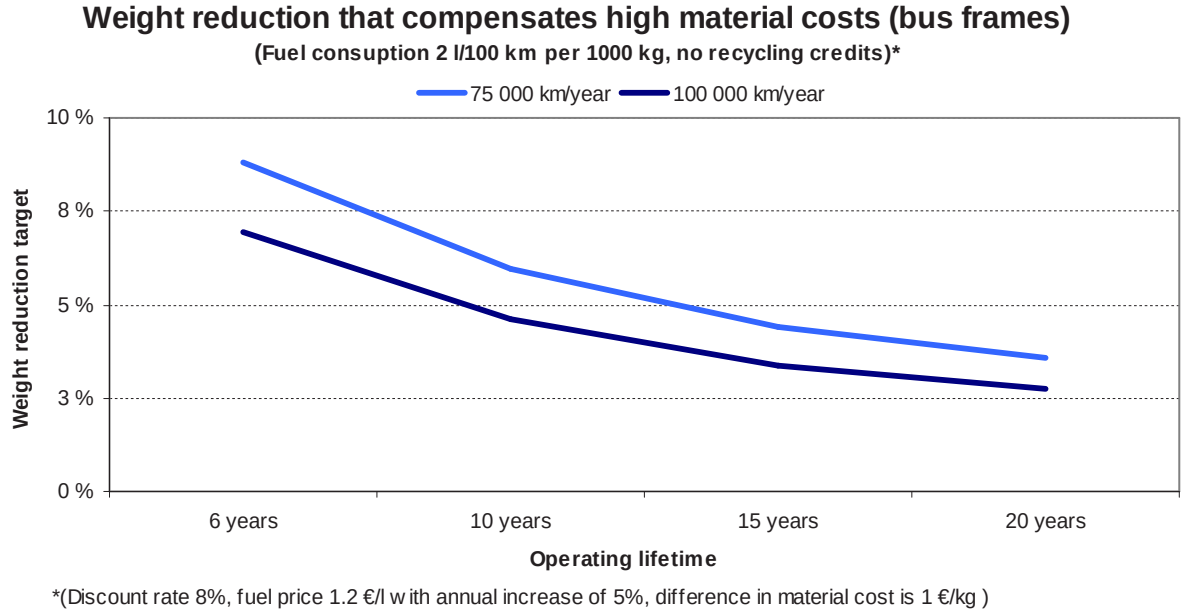

Figure 3. Proportional weight savings that offset a 1 € per kg higher material price in the life cycle fuel cost of bus components.

Weight reduction and overall vehicle weight plays a vital role in the environmental performance of a city bus. Bus-frame weight reduction makes it possible to either downgrade powertrain requirements or increase payload capacity. Both options increase the effectiveness of bus transport. Materials selection and bus-frame weight reduction are important and have positive environmental effects. Life cycle calculations show conclusively that reducing the weight of a vehicle lowers fuel consumption and can fully compensate for an initially higher material cost.

Because of the nature of the current project, i.e. dissemination of existing technical information and not creating new results, except in revising the LC calculations, no quantitative data for, e.g. bus maintenance and/or repair cost was available for inclusion in these calculations. Hence, the above conclusions are based on the cost effects of fuel consumption changes only. However, it should be born in mind that, apart from the LCC aspects, the excellent recyclability rate of stainless steel products, typically 95%, reduces their environmental impact considerably further.

3.3. WP3 – REVISION AND PUBLICATION: leader Euro Inox (4)

3.3.1. OBJECTIVES

- To revise the manuscript for publication in both paper and electronic form
  - language consultancy for the English language grammar check
  - readability increase of the handbook
- Publication, printing and European wide distribution of the finished handbook

- Conversion to electronic version
- Publication, duplication and European wide distribution of the electronic version

3.3.2. ACTIVITIES

During the final stages handbook manuscript construction work of WP1, it became evident that an extra technical meeting was needed between coordinator VTT and Euro Inox to finalise the manuscript technical contents for the preparation of print-ready manuscript. This resulted in some extra travelling costs for VTT, but the total project travelling costs could still be kept below the original budget. Following this editing session, the content of the handbook was revised by all project partners and the final approval was given by the project coordinator. The text of the handbook was refined from a more scientific into an easily readable form that is at the same time convenient for designers as a reference text. While all of the project partners use English as their second language, an additional grammar and style check was ensured by a skilled professional. In this way readability was increased, too.

Euro Inox provided editorial assistance and experience for the printing of the handbook. Because of time constraints, the production of the printing files was not left to a graphic design house, as originally planned. Instead, the adaptation of the original text files to a consistent format and style was performed in-house by Euro Inox.

Parallel to the manuscript finishing in WP1, Euro Inox had a uniform graphic looks prepared by a professional graphic designer to be available in time for the handbook printing, as well as other communication activities. Apart from the cover design of the printed – and later on CD – version of the handbook,
Figure 4, it also included the CD label, as well as project letterhead and presentation templates to be used for the seminar marketing and presentation preparation in WP4. The efficient realisation of the above tasks accommodated the printing of the paper version prior to the local seminars according to the original project plan.

Figure 4. An example of the uniform project graphic design: the cover and label of the CD-ROM version of the handbook. N.b. the front cover is on the right.

The dissemination of the printed handbook was also provided by Euro Inox. For that purpose a newly formed database with contact information of relevant people in transport industry was prepared. The project-generated database contains 873 contact addresses. Together with a relevant extract from the existing Euro Inox data base, it was used in two dual-purpose mail shots, which (i) announced the six regional seminars and (ii) gave non-participants an opportunity to request for a free copy of the INSAPTRANS report.

The copy of the handbook was handed out to all seminar participants. All persons in the database were informed that the handbook is available by request from Euro Inox free of charge. By December 2008, 1012 copies of the handbook were disseminated European wide. As free copies are still available through Euro Inox website, the process is still ongoing, although the project is finished.

The handbook was converted into a PDF file for publication on CD-ROM and can be downloaded or requested as a physical copy from Euro Inox website www.euro-inox.org. In addition to the text, which is identical to that in the paper version of the handbook, the presentations from the regional seminars and from the workshop were also included in the electronic version. The entry display of the CD can be seen in Figure 5.

Figure 5. The entry view of the handbook CD version.

3.4. WP4 – REGIONAL DISSEMINATION SEMINARS: leader Euro Inox (4)

3.4.1. OBJECTIVES

- To arrange six regional one-day seminars for the European wide result data dissemination
  - prospective locations: Scandinavia, Germany, France, Spain, Italy and UK or CEE
- Seminar arrangement responsibility at steel producers´
- Marketing and PR assistance from Euro Inox with local assistance where appropriate
- Target group: whole European ground transport industry sector and service supply chain

3.4.2. ACTIVITIES

Apart from their main purpose of disseminating the most recent knowledge on the use of stainless steels in transport applications, the seminars were seen as very important occasions and opportunities to create and gather new ideas for future development projects in the sector. This is closely related to the planned activities of WP5, where such brainstorming was carried out systematically. Both the above issues emphasised the importance of careful planning and early marketing of the seminars. The division of responsibilities was agreed upon already during the kick-off meeting together with the provisional locations at least on a country level. Some adjustments were made to the countries and locations listed in the proposal to improve the coverage of the seminars.

The essence of gathering on-line feedback from the seminars was emphasised as well. It was decided that a short and compact questionnaire similar in contents and exterior was used for each seminar to collect commensurate feedback. However, the questionnaire contents was translated to local language(s), where seen appropriate. The feedback will be dealt with separately later on in this chapter.

3.4.3. TASK 4.1: PRACTICAL ARRANGEMENTS

In the kick-off, the seminars were decided to be one half to one day in duration and tailored according to local needs and audiences. This meant that there was only one presentation dealing with the handbook itself, and the selection among consortium speakers was left to the local organiser. Furthermore, invitation of local speakers was encouraged. Thus, the balance between speakers representing project partners and those invited by the local organiser varied from seminar to seminar.

Another issue to be solved in seminar preparations was the need and possibilities for translations into local languages, and the practical means to realise this. In the end, this was left into the judgement of the organisers, and the practices varied from seminar to seminar. Each responsible partner carried out the preparatory work independently, typically with the aid of local stainless steel market development organisation, where available. In many cases, the involvement of these national associations and the use of in-house facilities of some of the project partners made it possible to reduce the cost of the seminars from the allocated lot. A summary of the organisers, dates, venues, etc. of each six seminars can be found in Table 2.

Table 2. A summary of key data of the six seminars

Seminar	Responsible organiser	Local assistance	Venue	Date	Days	Language
Germany	ArcelorMittal	Informationsstelle Edelstahl Rostfrei (ISER)	Innotrans, Berlin	25.9.	½	EN
France	ArcelorMittal	Institut de Développement de l'Inox (I.D. Inox)	Lille	30.9.	½	FR
Italy	CSM	Centro Inox	CSM, Rome	2.10.	½	IT, EN
Eastern Europe	Outokumpu	Polska Unia Dystrybutorów Stali (PUDS)	Warsaw, PL	7.10.	1	PL, EN
Spain	Acerinox	CEDINOX	Labein, Bilbao	9.10.	1	ES, EN
Scandinavia	Outokumpu		Tuusula, FI	16.10.	1	EN

3.4.4. TASK 4.2: MARKETING AND PR ASSISTANCE

This task was commenced as soon as the seminar dates and locations were fixed and was carried out in co-operation with responsible partner, possible local support organisation and Euro Inox. Euro Inox prepared a press release that was sent out to more than 70 publishing house addresses and was being displayed on their web pages as well. Additionally, the promotion of the seminars was done through the circular letters sent to all addressees in the newly formed database (873 addresses) were identified as having a potential interest in bus and rail applications. Furthermore, the INSAPTRANS partners as well as the national stainless steel development organisations involved, see Task 4.1, were making additional communicative efforts in their respective countries in the form of, e.g. press releases and web news pages. With all the above promotional activities a substantial and extensive seminar participation was ensured.

3.4.5. TASK 4.3: PREPARATION AND PRESENTATION

Apart from the locally tailored seminar programme, it was agreed among partners that five presentations of ~ 10 to 20 slides be prepared and made available to seminar organisers in order to help constructing the programme. The topics and the responsible partners were:

1. Corrosion aspects (Acerinox)
2. Materials selection and life cycle issues (Outokumpu)
3. Lightweight stainless steel structures (VTT)
4. Materials development (ArcelorMittal)
5. Project and handbook presentation (VTT and Euro Inox)

The presentation on the last topic was set a "compulsory" one that was given in each seminar for an introduction by a speaker from VTT (as the coordinator) or Euro Inox (as a "neutral" partner). The use of the material of the other presentations was left up to each individual organiser. The presentations for regional seminars were prepared in the respective local language where appropriate and on-stage translation was ensured where the public preferred having the presentations in their mother tongue (Italy, Poland). In the following, a short summary of each seminar prepared by responsible organiser will presented. The full seminar programmes have been collected in Appendix 1.

3.4.6. INSAPTRANS SEMINAR SUMMARIES

In the following, a brief summary is presented of each seminar. The summaries are prepared by the responsible organisers.

Berlin, Germany on 25 September, 2008
The seminar was linked with InnoTrans fair in Berlin. InnoTrans has become established as an international industry showplace focusing on railway technology. A full range of rail vehicles were presented in static displays on the Messe Berlin tracks located outside the exhibition halls. Other key InnoTrans features include Railway Infrastructure, Interiors, Public Transport, Transport IT, Services and Tunnel Construction and so a wide audience for the seminar was targeted. A satisfactory number of 34 people had registered, but unfortunately only 18 showed up. It could be concluded that the advantage of linking one's interests to a major event is debatable.

From the fabricators' side, representatives from Bombardier, Alstom and Stadler were present. Other stakeholders present were e.g.Voestalpine Profilform. The media were represented by Dr Wolfgart of BDS Stahlreport, who also prepared an article of the event in the following issue (Stahlreport 2008), Appendix 2.

The choice of topics (stainless metallurgy, metro cars' material use worldwide, zoom on current metro projects, manufacturing solutions with stainless) was well appreciated and the information was deemed useful. The clarity of the terminology was an asset to the audience. More information was requested regarding manufacturing methods (making metro cars out of stainless), sandwich panels and fatigue properties of welded structures. Material presented was given to the participants in a USB memory stick sponsored by ArcelorMittal Stainless Belgium.

Lille, France on 30 September, 2008
In the French seminar, 56 people registered and 39 showed up for this stand-alone event (i.e. not coupled to a major event). The rail car manufacturing industry was represented by Bombardier, France, and Alstom, France, as well as by profilers and engineering companies. The Paris subway authority RATP also sent a speaker delegate from the infrastructure department.

The following comments were distilled from the feedback forms: satisfied with information about roll forming, welding (especially about the focus on steel grades used in metro cars production grades such as 1.4318 and 1.4003), the gathering of all actors of the supply and value chain (i.e. steel suppliers, profilers, manufacturers, operators of fleet), the renewal of contacts in B2B environment (the seminar enabled to identify the right contacts). The critical tone of the RATP speaker was also appreciated. Further critical feedback was as follows (more info needed on):

- LCC examples
- Modern manufacturing techniques
- Finishes and finishing of stainless
- Understanding the image of stainless steels by end users (commuters)
- Stainless vs. other materials
- Importance of tailored blanks
- Potential loss of mechanical properties (especially cold worked) after welding

Media appearance was ensured for the French seminar in a form of an article, too (Focus Inoxydable 2008), Appendix 3. All the presentations were given to the participants in a USB memory stick sponsored by ArcelorMittal Stainless Belgium.

Rome, Italy on 2 October, 2008
A national seminar on "Stainless steel for structural components for land vehicles: guidelines for future development", organised in the frame of the INSAPTRANS project, was held at CSM in Rome. Supported by the European Union from the Research Fund for Coal and Steel (RFCS) the event intended to show the latest developments in the field of stainless steels for structural components in ground transport vehicles, especially for buses and trains. Effective information about stainless steel in different working environments was provided. The interaction with manufacturers opened up possibilities for future development of new stainless steels according to the needs of the market. By reduction of costs, improvement of characteristics, all possible opportunities should be analysed to determine the future development of new materials.

The seminar was attended by more than 50 participants from the major industrial companies of the sector all over Italy, such as Alstom Ferroviaria, Marcegaglia S.p.A., AT&Marketing, Alstom Transport, SO.GE.PAR. S.p.A., Italfer S.p.A., Outokumpu S.p.A., Federacciai, ThyssenKrupp Acciai Speciali Terni SpA, ESAB Saldatura S.p.A, Firema Transport S.p.A., C.A.M.S. S.p.A. and Italian Universities. Interesting contribution in terms of presentations were given by the invited speakers among the others:

- Dr. Eng. S. Raiti (AnsaldoBreda) showed the design of a light train from Los Angeles city - from the initial idea up to the production and testing.
- Dr. Eng. A. Bruno (ThyssenKrupp Terni) illustrated new stainless steels for structural components in the field of transportation.

High interest was shown from the audience during the presentations and the round table at the end of the seminar. It is worthwhile mentioning that questions came from the audience on the comparison between stainless steel, carbon steel and aluminium.

Warsaw, Poland on 7 October, 2008
In total 69 participants and 6 organizers were attending the seminar that was held in Oxford Tower in the city of Warsaw, Figure 6. This half a day seminar started with an outlook to the development of the transport industry in Poland. The presentation was given by the Managing Director of by the Polish Association of Steel Stockholders, Mr. Andrzej Ciepiela, who also welcomed the attendees. The two presentations about the project INSAPTRANS were divided in such a way that Mr. Mika Sirén from VTT presented both the scope of the project and the summary of the results from the light-weight structures. A lecture on the material selection was given by Mr. Tero Taulavuori from Outokumpu. A presentation on the duplex stainless steels was given by Mr. Pawel Chamczyk from Outokumpu. The seminar was closed after a panel discussion.

Figure 6. Audience in the Warsaw seminar on 7 October, 2008.

All the slide show presentations were translated in Polish and the local presentations were held in Polish, too. Translation was used in the two presentations held in English. Material presented in the seminar was given for the attendees in a CD-ROM. Seminar sponsor was Outokumpu-and the practical arrangements were taken care by the Polish Association of Steel Stockholders (PUDS). Based on the seminar evaluation, the information concerning stainless steels in general was found beneficial. The lectures were found competent and the choices presented were seen relevant. Even 33 persons were interested in participating to a workshop, but it might be interest on a local workshop instead of an international one. Also the Polish seminar was displayed in the media (Stal. Metale & Nowe Technologie 2008), Appendix 4.

Bilbao (Labein), Spain on 10 October, 2008

Altogether 26 participants (speakers not included) attended the Spanish seminar. It is worth mentioning the number of steel producers (4) and industry representatives (15) present; among the latter ones, 4 from the transport (train and bus) business. According to the feedback forms returned, the main topics of interest were:

- To establish the precise potential of each stainless steel type/grade in specific applications,
- To evaluate the true advantage of the stainless family over carbon steels,
- To increase the knowledge on ferritics (service properties in general, cold forming and weldability), and
- To know and assess the new trends in materials applications.

Special interest was expressed on the behaviour of the stainless steels with regard to crashworthiness performances as shown in the Bus project results. The seminar was also of interest to Labein metallurgy researchers belonging to the automotive business area according to the feedback after the event. The quality of presentations, in terms of topics addressed, information given and lecturers, was never rated below 3. On the down side, it is worth mentioning the lack of interest expressed in attending the final workshop.

Tuusula (Helsinki), Finland on 16 October, 2008

The seminar was held in Tuusula locating close to Helsinki City. The venue was Hotel and Conference Centre Gustavelund. The total number of participants was 35 persons from five countries, and the seminar had a full day program. All the lectures were held in English. The seminar was opened by Mr. Harri Soininen from VTT and the project outline and the lightweight stainless transport structures were presented by Mr. Mika Sirén from VTT. Material selection was presented by Mr. Tero Taulavuori from Outokumpu and the life cycle topics by Mr. Joona Säynevirta who changed his job from Helsinki University of Technology to Outokumpu a few months before the seminar.

The five presentations apart from the project INSAPTRANS were containing information on the stainless steel structural hollow sections, the results of the market study on the high strength stainless steels, energy absorption data in high speed deformations, recent development in high strength stainless steels and information on the rail car bodies and structures. The presentations were held by Mr. Pekka Yrjölä (Finnish Constructional Steelwork Association), Mr. Matti Isakov (Tampere University of Technology) and Prof. Hannu Hänninen (Helsinki University of Technology). Due to the absence of Ms. Minna Sellman from Outokumpu and Mr. Martino Celeghini from Siemens AG their presentations were partially held by the organizers. Closing remarks were given by Mr. Eero Rättyä from Outokumpu.

Material presented was given for the participants in a USB memory stick sponsored by Outokumpu. Based on the seminar evaluation the subjects presented in the seminar were ranked high and a full day seminar with a broad approach to the theme was seen particularly effective.

3.4.7. SEMINAR FEEDBACK RECEIVED PER QUESTION (ALL SEMINARS)

The feedback from all six seminars was collected. The same evaluation forms were used for all seminars. In nearly all the cases the evaluation forms were translated into the local language to avoid ambiguity. The answers of the participants were ranked on the scale from 1 to 5, which makes available statistical evaluation of the seminars. The common questionnaire form is enclosed as Appendix 5.

The number of participants and returned questionnaires per seminar have been collected in Table 3. It should be noticed that not all the questions were answered in all the returned forms, hence the occasional discrepancy in the number of answers between individual questions. Furthermore, the last two items in the questionnaire form were reserved for text comments. A summary of these comment was prepared for the workshop of WP5, hence this feedback will be presented in conjunction of WP5 reporting later on.

Table 3. A summary of the number of participants and returned feedback questionnaires.

Seminar	Location	Responsible organiser	No. of participants	Question-naires returned	Workshop participation OK
Germany	Berlin	ArcelorMittal	18	9	3
France	Lille	ArcelorMittal	39	19	12
Italy	Rome	CSM	50	34	24
Eastern Europe	Warsaw	Outokumpu	69	47	33
Spain	Bilbao	Acerinox	26	17	1
Scandinavia	Tuusula	Outokumpu	35	21	6
TOTAL			*237*	*147*	*79*

The evaluation of the practical information received showed that the participants evaluated the information as useful (with the peak at 4), Figure 7. As all the information could not be delivered during the seminar the handbook which was given to all the participants was considered as beneficial for later referencing.

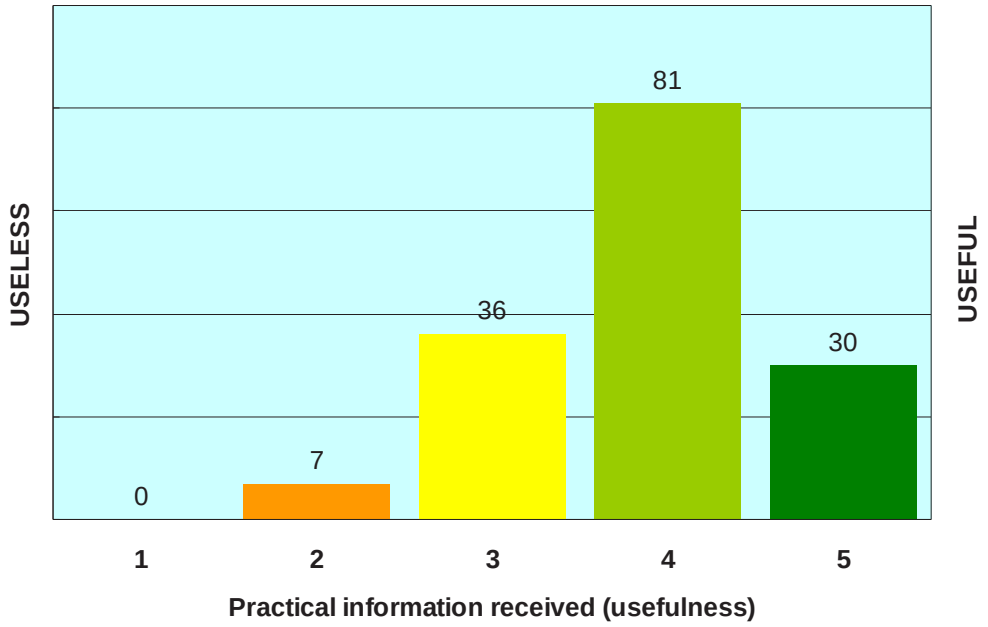

Figure 7. Marks on the usefulness of the information received in the seminars.

The participants were asked about the practical information received. Practical information received was evaluated as complete, with the peak also at 4, Figure 8.

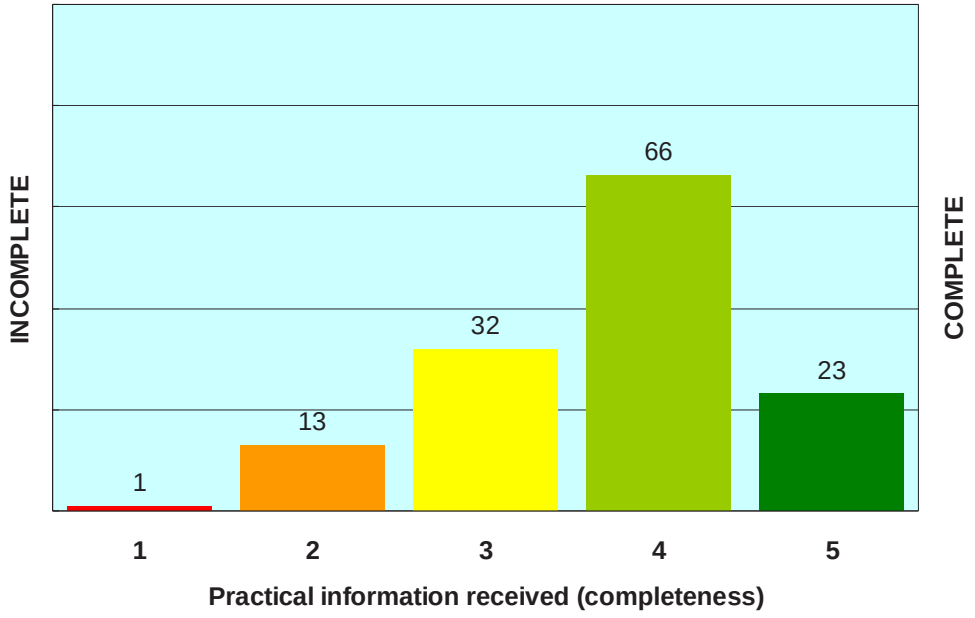

Figure 8. Marks on the completeness of the information received in the seminars.

The general feedback on the choice of topics presented showed that the topics were carefully chosen and that participants were satisfied with different topics presented, Figure 9. It has to be mentioned that some common presentations were available to all the seminars, but the agenda of each national seminar was in the hands of responsible project partner.

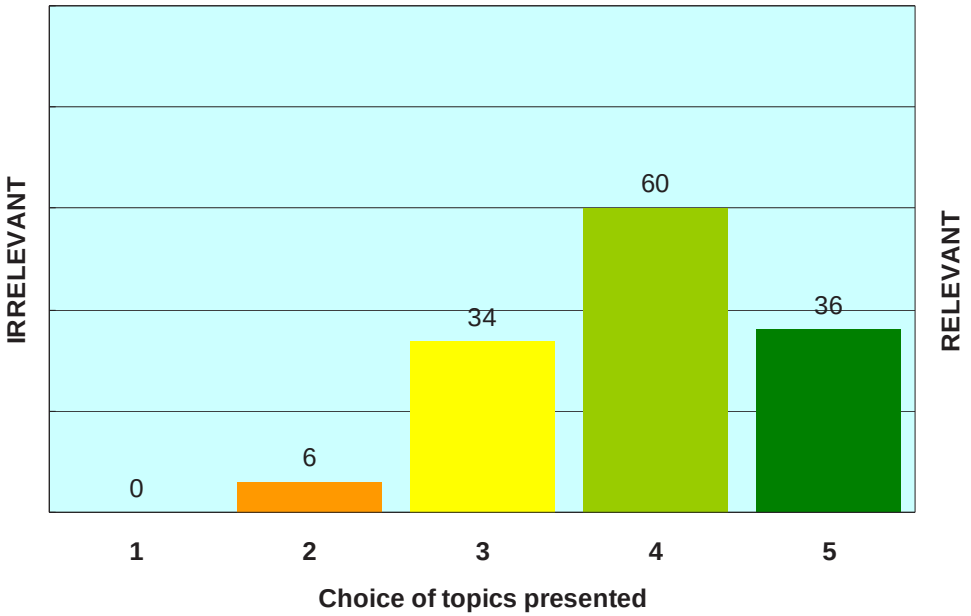

Figure 9. Marks on the relevancy of the information received in the seminars.

The participant group was very much diverse and usually from the whole supply chain (steel producers, profilers, distributors, vehicle producers, fleet operators, etc.) and that is very much obvious from the answers received on the question of applicability to their job, Figure 10. In this case it is considered as a benefit, while many different opinions were distilled from the discussion with all the stakeholders.

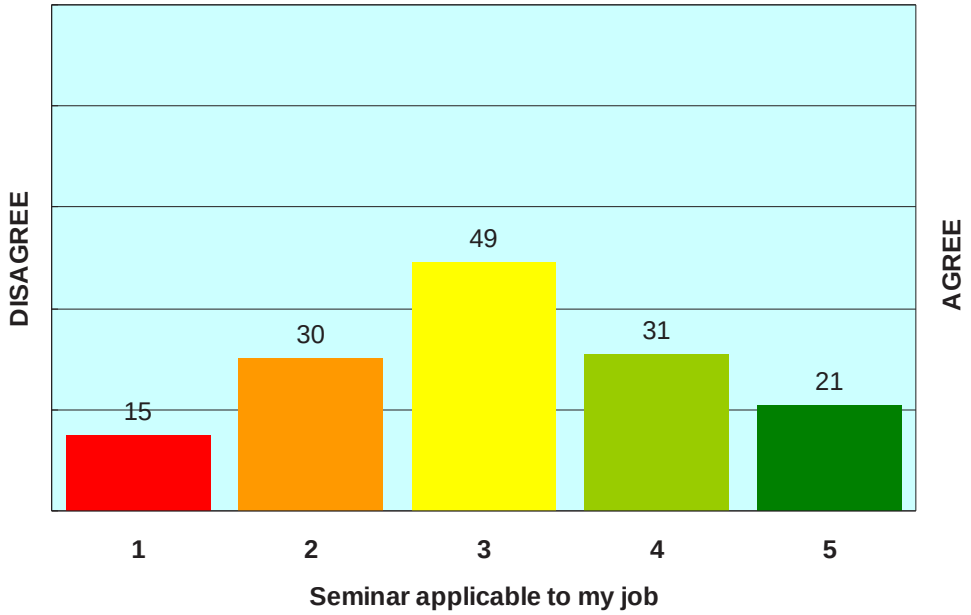

Figure 10. Marks on the applicability of the information received in the seminars.

The overall assessment of the lectures was very high, Figure 11. That reflects the quality of the presentations given, selection of the topics and the competent lecturers.

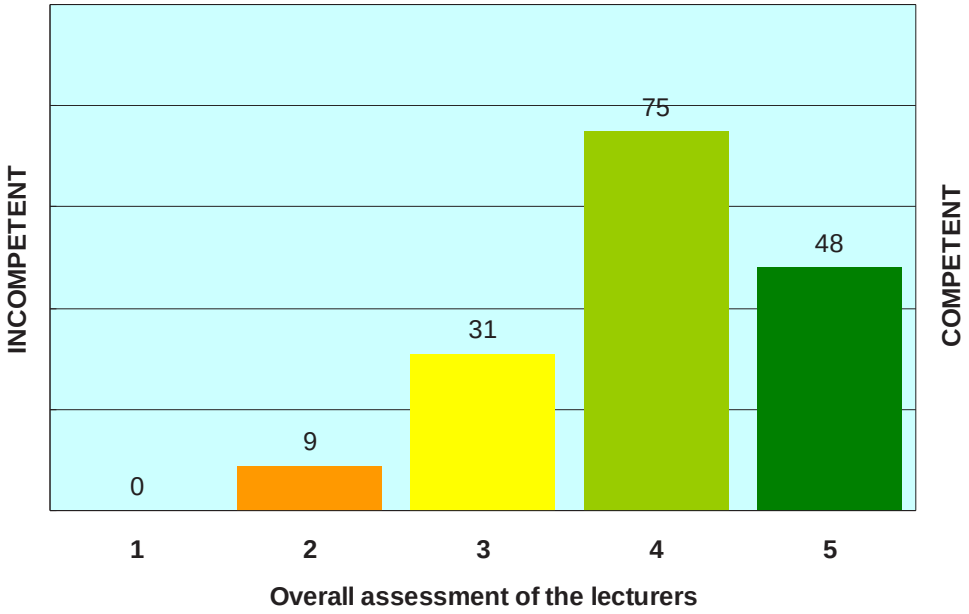

Figure 11. Marks on the speakers and presentations of the seminars.

3.4.8. SEMINAR FEEDBACK SUMMARY

A compilation of the results to all the questions is being represented in Figure 12. It can be clearly seen that from the audience point of view the seminar series was successful. From organisers´ angle, the number of participants in some seminars might have been higher, but the overall result is more than satisfactory.

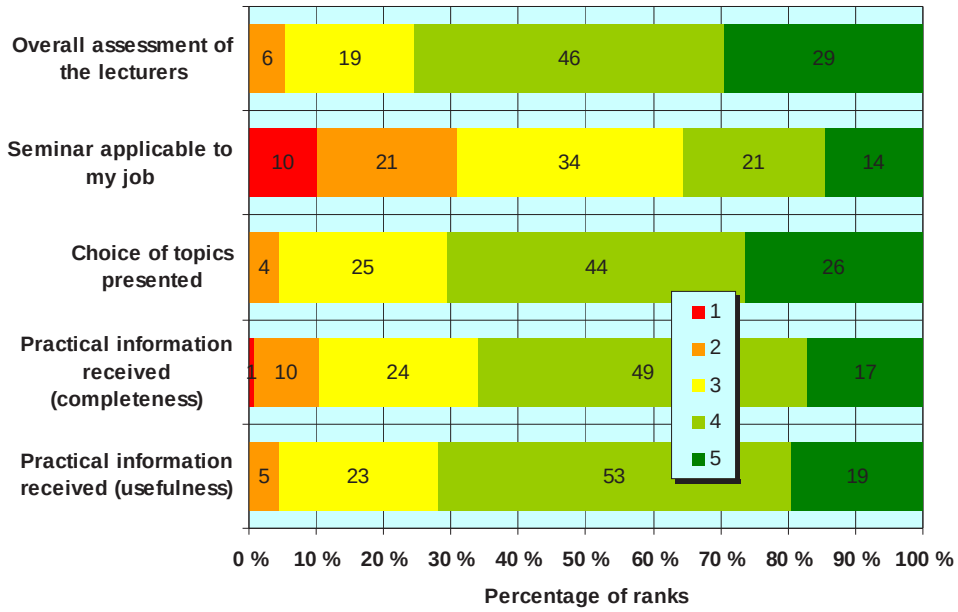

Figure 12. A compilation of the questionnaire results: percentage distribution of ranks for all the questions.

Most of the participants (almost 80 positive answers) revealed high interest in attending the workshop as the final event in the scope of the project. The seminars were held in September and October, 2008, just before the high impact of the financial crisis. However, as by the second part of November many companies had restricted and even abandoned all the travelling, the participation to the workshop was very much below the expectations, see WP5 for details.

3.5. WP5 – R&D NETWORKING & FORESIGHT WORKSHOP: leader CSM (3)

3.5.1. OBJECTIVES

- To arrange a workshop on networking and future research actions in European ground transport industry
- Industrial, research and academic sectors on invitation basis
- Feedback from the seminars
- Planning of future R&D initiatives

3.5.2. ACTIVITIES

The responsible partner CSM has provisionally proposed their facilities in Rome for the workshop. In order to have enough feedback from all the seminars, a provisional time frame for the workshop was set on 28 November, 2008. The workshop date was to be fixed earliest possible to be able to invite the appropriate participants in due time. Furthermore, it was decided that the project final meeting be held in conjunction with the workshop to avoid excessive travelling during the extremely busy season of the year.

The workshop was to be arranged on an invitation basis only. The invitation list was complemented with the names of the people who had expressed their interest in the workshop in the seminar feedback questionnaire. This resulted in almost 100 names that were contacted with an invitation letter.

The workshop programme was constructed in a way that allowed enough time for discussion among the participants. Therefore, three topics were selected for keynote addresses followed by a 35 min discussion. Additionally, the breaks were scheduled long enough to allow space for further adjustments, if necessary. The final workshop programme is in Table 4.

Table 4. The final workshop programme.

Time	Title/topic	Speaker	Chairman
9.00	*Coffee and registration*		
9.45	Welcoming address Project and handbook presentation	Leopoldo Rizzo (3) Mika Sirén (1)	Leopoldo Rizzo (3)
10.00	Keynote I: Future perspectives of rail and metro markets	Alenka Kosmač (4)	
10.30	Discussion on Keynote I		
11.00	Keynote II: Materials development and selection	Benoît van Hecke (7)	
11.30	Discussion on Keynote II		
12.00	*Lunch and networking break*		
13.30	Keynote III: Stainless steel structures	Mika Sirén (1)	Tero Taulavuori (5)
14.00	Discussion on Keynote III		
14.30	*Coffee break*		
14.45	Final discussion, summary and closing remarks		Tero Taulavuori (5)

Topics of the workshop presentations were specified as follows:

- Ferritics – Austenitics – Duplex grades: where to use what?
- High-strength steels – the stainless solution
- Design innovations: sandwich panels and hydroformed nodes
- Forming and joining: specific assets of stainless steels

As for the round table discussions following the keynotes, the following topics were anticipated:

- Technical criteria of material selection: What does the fabricator want?
- Customer expectations: What does the operator want?
- The economics of material selection: how important is Life Cycle Costing?
- Maintenance and repair: what are the priority issues?
- Research and development: Where is more information needed?

The workshop was scheduled for the day following the project final meeting. Despite of the worrying advance information from CSM, it was noticed in the meeting that the number of participants was disappointing: the total number of workshop attending participants was ten, which was a clear disappointment as compared to the expected total number of about 20 to 30. The abrupt change in the economical situation may have contributed in this, but also the time gap between the seminars and the workshop may have been too short – a couple of months´ maturing time might have produced different results from the workshop point of view. On the other hand, the total time available for this type of dissemination project was also limited. Still, it can be concluded that the level of discussion in the workshop was high enough to at least partially compensate for the small number of attendees.

3.5.3. WORKSHOP SUMMARY

The Project Steering Group chairman, Mr Tero Taulavuori, prepared a summary of the workshop for the final discussion. In the following, the text comments feedback from the seminars are grouped according to the keynote address titles together with the outlines for the future R&D co-operation in the future developments. The items among seminar feedback that were also especially highlighted in the workshop discussions are indicated with bold font. It can be seen that the trends in the topics raised in the seminars and the workshop outcome are very similar to each other. All the presentations from the workshop including the final remarks are included in the CD version of the INSAP-TRANS handbook (Sirén et al. 2008). Apart from national or local programmes, suitable R&D finance frameworks are to be screened in, e.g. the EU 7th framework programme calls, especially the industrial and in particular SME driven ones. The explanation for the latter is that many of the road transport equipment manufacturers are SME´s.

Keynote I – Stainless steel in passenger transport: Future perspectives of rail and metro markets

Seminar feedback

- Bring together the decision makers in whole value chain
- **Real cases of application**
- Case studies on life cycle costing
- Cost analysis in transport
- Inventory of all stainless steel applications known
- **More studies on crashworthiness of materials**
- **Need for prefabricated stainless steel components**

Workshop contribution

- Need for replacement of existing rail, light-rail and metro fleet will grow heavily by year 2020 in Europe
- Fire safety: shielding of the critical components, e.g. fuel tanks. Fire resistance of lightweight structures
- Safety: customer specifications are well above legal rules
- Vandalism resistance: mainly for rails, only graffito?

Keynote II – Materials development and selection

Seminar feedback

- Comparison with other materials
  - Applications for duplex grades
  - Ferritic grades to substitute austenitics or HSS (carbon steels)
  - Substitution of aluminium in corrosive environment
- **Dissimilar material welds**
- **Simulations and testing of fire safety e.g. in tunnel fire**
- Maintenance of stainless steel structures

Workshop contribution

- Railway cars (life cycle > 30 years): Potential for austenitic and duplex grades with enhanced material properties
- Mn alloyed austenitic stainless steel grades could also be a promising future solution
- Buses (life cycle < 20 years):
  New alternatives to grade 1.4003 may be attractive when corrosion resistance and mechanical properties could be improved without a dramatic price increase
- Maintenance does not require particular R&D work.

Seminar feedback

- **Design of welded details for fatigue. Large scale testing, spot welded structures etc.**
- Adhesive bonding of stainless steels. → **Mechanical joining**
- **Spatial analysis for sandwich constructions (torsion and stability)**
- Extruded panel production
- **Realisation of profiles (compressive testing, bending)**

Workshop contribution

- Re-designing and modification during the manufacturing. Information on fabrication is essential.
- Repairability of the structures; e.g. welding consumables, cumulative heat input corrosion resistance and galvanic effects. Both R&D and information spread
- Importance of fuel consumption is increasing
- New testing methods for frame structures?

3.6. WP6 – COORDINATION: WP leader VTT (1)

3.6.1. OBJECTIVES

- To manage and co-ordinate the project
- To keep the project budget and schedule
- To ensure of high quality project reporting in the set schedule
- To maintain adequate communication between all the partners and sub-contractors involved in the project in order to achieve the project objectives
- To liaise with the RFCS scientific officer in project matters

3.6.2. ACTIVITIES

The INSAPTRANS project was launched in the kick-off meeting held at VTT premises in Espoo, Finland on 31 July, 2007. The Project Steering Group (PSG), consisting of representatives from each partner, concluded that according to the project hierarchy, the PSG, i.e. the contractors, is above the coordinator in decision-making process in the case conflicts occur. Furthermore, it was decided in the kick-off that a regular chairman from industry and a secretary be elected for the PSG. Tero Taulavuori of Outokumpu Stainless was selected unanimously for the PSG chairman and Mika Sirén of VTT for the PSG secretary. The original members of the Project steering Group were (contractor number in brackets):

Mika Sirén	VTT	(1)
Nico de Wispelaere	OCAS N.V.	(2)
Leopoldo Rizzo	Centro Sviluppo Materiali (CSM) S.p.A.	(3)
Thomas Pauly	Euro Inox ASBL	(4)
Tero Taulavuori	Outokumpu Stainless Oy	(5)
Rafael Sánchez	Acerinox S.A.	(6)
Raf Thys	Ugine & ALZ Belgium N.V.	(7)
Hannu Hänninen	Helsinki University of Technology	(5.1)

Some personnel changes to this steering group composition were experienced during the project and they will be dealt with separately later on in Chapter 3.6.4.

Further common kick-off decision dealing with project coordination that electronic communication was to be preferred where possible, including, e.g. meeting invitations, minutes (one signed paper copy prepared and archived by the coordinator VTT), etc., and that all these documents were to be filed in the DoHa system for easy access to PSG members, see also WP1. Consequently, it was agreed that an e-mail is sufficient for the "prior written approval" mentioned in connection of releasing other publications.

It was also seen in the beginning that the timing of individual WP´s and tasks was essential because of the short project time of 18 months. Hence, some adjustments were necessary in the original schedule to ensure of timely execution of the project and especially the dissemination seminars:

- The paper version of the handbook had to be ready and printed out prior to the seminars to allow the distribution to participants. In practise, this meant tightening of the schedules of work packages WP1 to 3 for about two months
- The date of the PSG2 meeting was advanced correspondingly from the originally proposed, i.e. from March 2008 to early January
- The dates and locations for the seminars had to be fixed earliest possible in order to reserve the facilities and start the local PR efforts, thus the major details – on a country and city level – were confirmed in the PSG2 meeting
- In order to have time to collect enough feedback from the seminars, a tentative time frame for the workshop of WP5 was fixed on the latter half of November, 2008 in the PSG2 meeting

3.6.3. PROJECT MEETINGS

The preparation of the handbook manuscript and the arrangement of the seminar series required extensive organisation and co-operation between partners. In order to ensure of the timely execution of both these key actions, the coordinator calledd two additional technical meetings between the PSG2 and PSG3 Final meeting. The first was organised in conjunction of "6th European Stainless Steel Conference – Science and Market (SSSM 08)" conference on 1 June in Helsinki. This arrangement helped in reducing the project travel costs, since most of the partners had the conference scheduled regardless of the meeting.

The second technical meeting was called between VTT and Euro Inox on late June in order to finalise the handbook manuscript work of WP1 for the preparation of the print-ready manuscript in WP3. It was foreseen that these actions had to be carefully planned and coordinated before the coming summer holiday season – otherwise the time had been too scarce for guaranteed handbook delivery for the first seminars in the end of September. A summary of the three Project Steering Group (PSG) meetings and two Technical Meetings (TM) called by the coordinator in chronological order is as follows:

- The kick-off meeting (PSG1) on 31 July, 2007 at VTT premises in Espoo, Finland.
- The second project steering group meeting (PSG2) on 8 January, 2008 at Euro Inox in Brussels, Belgium
- The first technical meeting (TM1) in conjunction of "6th European Stainless Steel Conference – Science and Market (SSSM 08)" conference on 11 June, 2008, hosted by Outokumpu Stainless in the conference premises in Helsinki, Finland
- The second technical meeting (TM2) between VTT and Euro Inox on 26 June, 2008 at Euro Inox in Brussels, Belgium
- The third and final project steering group meeting (PSG3), immediately prior to the WP5 workshop, on 27 November, 2008 at CSM in Rome, Italy

3.6.4. CHANGES IN THE PROJECT ORGANISATION

There were some changes in the project organisation both in respect of personnel changes by partners and company organisation renewals.

- Alenka Kosmač started working at Euro Inox and in the project steering group on 1 January, 2008
- The authorised contact person of Ugine & ALZ Belgium, Raf Thys, changed position within the ArcelorMittal group from the beginning of 2008. His successor in the project was Roeland Vliegen
- Benoît Van Hecke started his project steering group work on January, 2008
- The business name of Ugine & ALZ Belgium was changed to ArcelorMittal Stainless Europe (AMSE), which was used in parallel with the previous name that is recorded in the official project documents, e.g. the project contract

3.6.5. PROJECT PUBLICATIONS

Apart from the project main deliverables, namely the paper and electronic versions of the handbook, publications were prepared based on the DOLTRAC project results utilising INSAPTRANS project funding. It was seen that, although not anticipated in the project proposal, they would complete the pro-

ject deliverables and, above all, work for the ultimate project goal, i.e. disseminating the data on stainless steel utilisation. Thus, altogether four publications were prepared and published, namely two conference papers and two journal articles. The two latter articles are identical in contents, but published in different Finnish professional journals for maximum coverage.

- Sirén, Mika; Gales, Anton; van Hoecke, Dennis; Sánchez, Rafael. High strength stainless steel sandwich panels for transport applications. 2007. Proceedings of IIW International Conference Welding & Materials – Technical, economic and ecological aspects. Cavtat, Kroatia 5 – 6.7.2007. Welding in the World. International Institute of Welding IIW, Croatian Welding Society. Zagreb. Vol. 51 (2007) No: Spec. iss. ISBN 978-953-7518-00-4. pp. 327 - 338
- Sirén, Mika; Gales, Anton; van Hoecke, Dennis; Sánchez, Rafael; Säynäjäkangas, Jukka. Innovative stainless steel panel applications for trans-port industries. Proceedings of the 6th European Stainless Steel Conference – Science and Market. June 10 – 13, 2008, Helsinki, Finland. 2008. Jernkontoret, Stockholm. ISBN 91-974131-9-4. pp. 681 – 688.
- Sirén, Mika and Säynäjäkangas, Jukka. High strength stainless sandwich panel structures in transport applications. Hitsaustekniikka (Welding Technology: the journal of The Welding Society of Finland) 58 (2008) no. 1. ISSN 0437-6056. pp. 7 – 12. *(in Finnish)*
- Sirén, Mika and Säynäjäkangas, Jukka. High strength stainless sandwich panel structures in transport applications. Ohutlevy (Sheet metal journal) (2008) no. 1. ISSN: 1239-4122. pp. 16 – 20. *(in Finnish)*

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Aluminium Taschenbuch, 14. Auflage (3., datenaktualiserter Druck 1988). 1988. Düsseldorf: Aluminium-Verlag. ISBN 3-87017-169-3. p. 65

Insaptrans auf der InnoTrans. Auf die Schiene gestzt. 2008. Stahlreport 10/2008. p. 16

L´inox dans l´industrie des transports collectifs: une nouvelle offre. 2008. Focus inoxydable 4/2008. pp. 12 – 14

Mäkelä, K. 2008. Unit Emissions in Finland, Passenger transport.

Nylund N-O. 2006. Raskaan ajoneuvokaluston energiankäytön tehostaminen "HDEnergia", Yhteenvetoraportti 2003-2005, Projektiraportti, VTT-R-03125-06, 27.03.2006. 76 p. *(in Finnish)*

Sirén, M., Taulavuori, T., de Wispelaere, N., Rizzo, L., Thys, R., Vliegen, R., van Hecke, B., Pauly, T., Kosmač, A., Sánchez, R., Säynevirta, J., Hänninen, H., Pohjanne, P., Tonteri, H., Ala-Outinen, T. (eds.). 2008. Innovative stainless steel applications in transport vehicles. The main outcome of the ECSC/RFCS project "Innovative stainless steel applications in transport vehicles" (INSAPTRANS: contract RFS2-CT-2007-00025) (2008), 125 s. Available in print and CD form at http://www.euro-inox.org/

Euro Inox. 2006. Design manual for structural stainless steel (Third edition). Building Series, Volume 11. Brussels: Euro Inox. ISBN 2-87997-204-3. 114 p. + 85 p. design examples. Also available for download at URL: http://www.euro-inox.org/

Seminarium „INSAPTRANS – zastosowanie stali odpornych na korozję w transporcie samo-chodowym". 2008. Stal. Metale & Nowe Technologie 11/2008. p. 25

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APPENDIX 1

Full seminar programmes

Seminar programmes

Berlin, Germany, 25 September, 2008

1. Innovative stainless steel applications in transport vehicles.
   Mika Sirén, VTT
2. Use of Stainless Steel in Railcars outside Europe.
   Peter Cutler, Nickel Institute
3. Industrialising the Stainless Steel Body Shell for a new Metro Car.
   Ben Boese, Alstom Transport
4. Work hardening and profiling. Exploiting stainless steel's forming potential.
   Benoît Van Hecke, ArcelorMittal Stainless Europe
5. Lightweight stainless steel transport structures.
   Mika Sirén, VTT
6. Solutions for passenger transport applications.
   Roeland Vliegen and Benoît Van Hecke, ArcelorMittal Stainless Europe

Lille, France, 30 September, 2008

1. Utilisations innovantes de l'acier inoxydable dans les véhicules de transport - 1 Présentation du projet.
   Thomas Pauly, Euro Inox
2. Utilisation de l'inox pour le matériel roulant ferroviaire (hors Europe).
   Peter Cutler, François Moulinier, Nickel Institute
3. Perception du matériau INOX.
   Sandrine Darcis, RATP-Délégation Générale à l'Innovation et au Développement Durable
4. Les atouts de l'inox.
   Benoît Van Hecke, ArcelorMittal Stainless Europe
5. Utilisations innovantes de l'acier inoxydable dans les véhicules de transport - 2 Présentation du manuel.
   Thomas Pauly, Euro Inox
6. Le soudage des "aciers inox pour le ferroviaire".
   François Maltrud, Institut de Soudure.
7. Le profilage des inox en introduisant des notions sur l'écrouissage.
   Benoît Van Hecke, ArcelorMittal Stainless Europe
8. Les solutions inox pour le transport des passagers.
   Philippe Richard, ArcelorMittal Stainless Europe

Rome, Italy, 2 October, 2008

1. Applicazioni innovative dell'acciaio inox nel settore del trasporto su ruote - INSAPTRANS. Introduzione al progetto ed al manuale.
   Leopoldo Rizzo, CSM
2. L'acciaio inox per componenti strutturali dei veicoli per il trasporto terrestre: linee guida per lo per sviluppo futuro.
   Andrea Bruno, ThyssenKrupp AST
3. Seminario –L'acciaio inossidabile per componenti strutturali dei veicoli per il trasporto terrestre: linee guida per lo sviluppo futuro.
   Stefano Raiti, Ansaldobreda
4. The landscape of 'classic'and 'alternative'stainless steels grades.
   Alenka Kosmač, Euro Inox

Warsaw, Poland, 7 October, 2008

1. Zastosowanie stali odpornych na korozje w transporcie samochodowym. Sektor Komunikacji Miejskiej w Polsce.
   Andrzej Ciepiela, PUDS
2. Nowatorskie zastosowania stali nierdzewnej w pojazdach transportowych - INSAPTRANS - Tresc projektu i poradnika.
   Mika Sirén, VTT (given in English)
3. Lekkie konstrukcje pojazdów transportu publicznego ze stali nierdzewnej.
   Mika Sirén, VTT (given in English)
4. Dobór materiału – Polepszenie własnosci stali nierdzewnych.
   Tero Taulavuori, Outokumpu Stainless (given in English)
5. Stale Duplex – Grupa wysoko wytrzymałych gatunków stali nierdzewnych.
   Pawel Chamczyk, Outokumpu Poland

Bilbao, Spain, 10 October, 2008

1. RFCS INSAPTRANS.
   Rafael Sánchez, Acerinox
2. Innovative stainless steel applications in transport vehicles.
   Mika Sirén, VTT
3. Materials –FutureDevelopments in Stainless Steel.
   Rafael Sánchez, Acerinox
4. The corrosion resistance of stainless steels.
   Rafael Sánchez, Acerinox
5. Lightweight stainless steel transport structures.
   Mika Sirén, VTT
6. Welding, Forming Stainless Steels.
   Rafael Sánchez, Acerinox
7. Vehicle weight effect on life cycle of heavy transportation.
   Rafael Sánchez, Acerinox
8. Aspectos novedosos en las tecnologias de Conformado. Aplicaciones del Conformado. Electromagnético en Componentes de Automoción.
   Marian Gutierrez, LABEIN Tecnalia Automoción
9. Estampación de aceros inoxidables austeníticospara piezas estructurales en el sector de automoción.
   Rafael Villaseca, Batz S. Coop

Tuusula, Finland, 16 October, 2008

1. Innovative Stainless Steel Applications in Transport Vehicles - Opening words.
   Harri Soininen, VTT
2. Lightweight Stainless steel Transport Structures.
   Mika Sirén, VTT
3. Material Selection -Future Developments in Stainless Steel.
   Tero Taulavuori, Outokumpu Stainless
4. Life cycle effects of heavy transportation.
   Joona Säynevirta, Outokumpu Stainless
5. Design Guidelines for Structural Hollow Sections of Stainless Steel.
   Pekka Yrjölä, Finnish Constructional Steelwork Association (FCSA)
6. Results of Market Research for High Strength Stainless Steels.
   Minna Sellman, Outokumpu Stainless
7. Effect of Strain Rate on Energy Absorption of Stainless Steels.
   Matti Isakov, Tampere University of Technology, Department of Materials Science
8. Development of high-strength stainless steels and their applications.
   Hannu Hänninen, Helsinki University of Technology, Laboratory of Engineering Materials
9. Stainless Steel for advanced car body components in modern streetcar.
   Martino Celeghini, Siemens AG - Industry Sector Mobility Division - Light Rail Development

APPENDIX 2

Insaptrans auf der InnoTrans. Auf die Schiene gesetzt.

Stahlreport 10/2008. p. 16

Insaptrans auf der Innotrans

Auf die Schiene gesetzt

Der Schienenverkehr hat ein großes Marktpotenzial und bietet bedeutende qualitative Herausforderungen. Deshalb wurde auf der Fachmesse Innotrans in Berlin das Projekt Insaptrans auf die öffentlichen Schiene gesetzt – und damit nichtrostende Stähle.

Bereits seit einigen Jahren erforscht ein Konsortium, zu dem auch ArcelorMittal gehört, die Chancen nichtrostender Stähle im Verkehrswesen, insbesondere für Eisenbahnwaggons und Busse. Hintergrund für dieses europäisch geförderte Projekt (Innovative Stainless Steel Applications in Transport Vehicles/INSAPTRANS) war die Beobachtung, dass entsprechende Werkstoffe beispielsweise in Amerika und Asien für diesen Sektor intensiv genutzt werden, nicht aber in Europa. Deshalb bot es sich mit der INNOTRANS, der weltgrößten Fachmesse für Verkehrstechnik, Ende September in Berlin an, den Stand der entsprechenden Erkenntnisse im Rahmen eines Seminars vorzustellen, zu dem neben ArcelorMittal auch die Informationsstelle Edelstahl Rostfrei (ISER) eingeladen hatte.

Dokumentation zum **INSAPTRANS-Projekt**

Zusammenfassende Kennziffern für die zahlreichen wirtschaftlichen, technischen und ästhetischen Vorteile nichtrostender Stähle gegenüber anderen Stahlwerkstoffen, vor allem aber auch gegenüber Aluminium, sind die kompletten Lebenszykluskosten – von der Erzeugung des Materials bis hin zum Recycling der daraus hergestellten Produkte. Nach Angaben aus dem Nickel Institute sind diese Kosten bei Aluminium fast doppelt so hoch wie bei nichtrostenden Stählen, werden aber bei der Verwendung schwarzer Stähle nochmals getoppt. Gewichtsaspekte sowie das Crashverhalten und die Situation im Brandfall gehören zu den technischen Vorteilen nichtrostender Stähle gegenüber Aluminium, das in Deutschland auf dem Verkehrssektor seine größte Absatzgruppe hat.

Der so deutlich werdende Wettbewerb der Werkstoffe ist vor allem deshalb so interessant, weil Westeuropa auch in Zukunft der größte Markt für die Eisenbahnindustrie bleibt, wie auf der Innotrans deutlich wurde. Der jährliche Zugangsmarkt für die Eisenbahnindustrie liegt bei 86 Mrd. Euro. Das ist eine der Kernaussagen einer aktuellen Studie von Roland Berger Strategy Consultants, und weiter: Mit derzeit 29,3 Mrd. Euro wird Westeuropa dabei auch weiterhin den größten Markt darstellen. Bis 2016 rechnen die Gutachter mit einem weltweiten Wachstum von 2,9 % jährlich.

Eine Besonderheit bei der Erschließung dieser Märkte ist es, dass Umweltfreundlichkeit ein Muss darstellt. Die Dimensionen der Herausforderungen formulierte Verkehrskommissar Antonio Tajani, EU-Vizepräsident, zur Eröffnung der Innotrans wie folgt: „Dabei stehen wir vor großen Herausforderungen – das Verlangen nach Mobilität muss den Kosten der Verkehrssysteme ausgewogen gegenüberstehen. Die Verlagerung auf energieeffiziente Verkehrsträger wie die Bahn muss weiter energisch betrieben werden." ©

APPENDIX 3

L´inox dans l´industrie des transports collectifs: une nouvelle offre

Focus inoxydable 4/2008. p. 12 – 14

ID Inox : Institut de développement de l'inox

L'inox dans l'industrie des transports collectifs : une nouvelle offre

Un consortium industriel[1] composé de producteurs d'acier inoxydable et d'instituts de recherche et les associations nationales de développement de l'inox (I.D. Inox pour la France) ont organisé, en septembre et octobre 2008, six séminaires à travers l'Europe, afin de présenter les résultats du projet de recherche : « L'inox, une réponse aux besoins du matériel roulant dans les transports collectifs ».

Les producteurs européens d'inox ont en effet décidé, voici 3 ans, de lancer ce projet de valorisation, soutenu en partie par l'Union Européenne des fonds de recherche pour le charbon et l'acier (RFCS[2]), avec pour objectif de rendre disponible à un public élargi les résultats de deux études [3] scientifiques préalables, destinées à évaluer l'intérêt du matériau inox dans le matériel des transports en commun : voitures de chemins de fer, rames de métros et de tramways, bus.

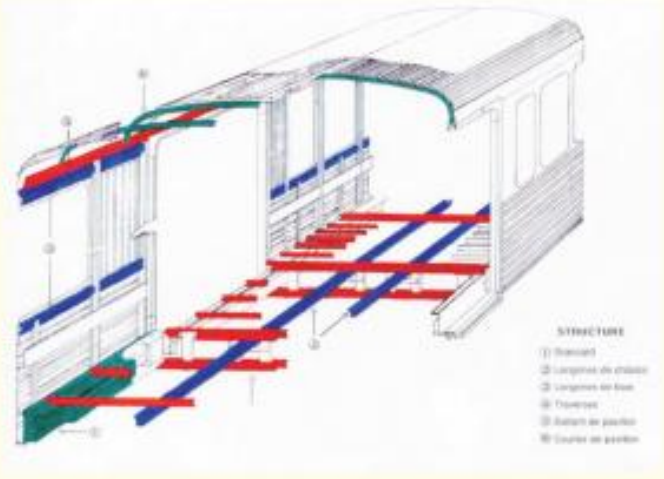
Ce projet baptisé Insaptrans ("Innovative Stainless steel Applications in Transport vehicles") est maintenant achevé [3] Les entreprises et associations impliquées disposent d'une base documentaire solide mettant en évidence les qualités de l'inox tant sur le plan technique qu'économique en considérant la durée des investissements ainsi que le confort et la satisfaction de l'usager.

Les donneurs d'ordre, les fabricants de ces matériels et leurs sous-traitants, les transformateurs (profilage, soudage,...), et producteurs d'acier se sont donc rencontrés pour présenter les résultats, dresser un panorama des expériences récentes dans la construction de bus et dans l'utilisation d'inox pour des wagons ou rames ultra-légers, et faire part des dernières avancées techniques sur le matériau.

Cette ambition affirmée pour l'inox s'ancre dans un savoir faire qui était bien français jusque dans les années 80, mais qui s'est perdu dans notre pays comme chez la plupart de nos voisins européens. Parallèlement, les Etats-Unis, et bon nombre d'autres régions du monde comme l'Asie, ont eu recours dès les années 30 à l'inox en revêtement et en structures des wagons de chemin de fer, prioritairement en raison de l'allégement du poids des matériels, déjà critère majeur à l'époque. Des bus et tramways de plus de 20 ans circulent d'ailleurs encore à la satisfaction des sociétés de transports et des usagers.

Malgré une densité élevée (donc apparemment plus lourd) et un prix d'achat supérieur, l'inox est dans ces pays un matériau de prédilection et le demeure, puisque pour ne citer qu'un exemple, en Inde, un programme de renouvellement des trains longue distance va se faire avec des wagons tout inox.

L'on peut dès lors s'étonner qu'un matériau si prisé, et qui a fait ses preuves dans la durée, ne soit pas reconnu de la même façon et utilisé largement par les constructeurs européens. Pour le comprendre, connaître les défis à relever et trouver des réponses adaptées, les industriels se sont tournés, à l'occasion de ces séminaires, vers les donneurs d'ordre.



Squelette de voiture de métro

Les besoins des donneurs d'ordre

Le constructeur industriel de matériel roulant choisit le matériau, non en fonction de ses qualités intrinsèques, mais en fonction de sa capacité à satisfaire des exigences fonctionnelles :

- De facilité d'approvisionnement
- De facilité de mise en oeuvre
- Liées contraintes de transport : accélération (poids), capacité passagers, longueur de quais
- De facilité de réparation
- De durabilité
- De résistance aux intempéries (y inclus climat marin)

- D'adaptation aux agressions urbaines : pollution et vandalisme

Il s'agit pour les donneurs d'ordre de faire le meilleur choix d'une solution intégrale de caisson qui respecte à la fois les performances techniques attendues et la maîtrise du coût total, comprenant l'achat du matériau, la maintenance et la durée d'exploitation des matériels.

Il est à noter que certains avantages de l'inox, appréciés dans d'autres secteurs - surface lisse et résistante par exemple - n'apparaissent pas comme un atout dans ce domaine : ainsi, beaucoup de voitures sont peintes pour se conformer à l'identité visuelle de l'opérateur ferroviaire, alors que l'inox ne nécessite aucun revêtement.

Les atouts de l'inox

Une "radiographie" d'une voiture de métro permet de mieux comprendre les exigences posées au matériau de construction, et par conséquent les attentes des donneurs d'ordre. Le diagramme ci-dessous montre des pièces de structure, panneaux, profils et toiture qui se prêtent particulièrement à une fabrication en inox.

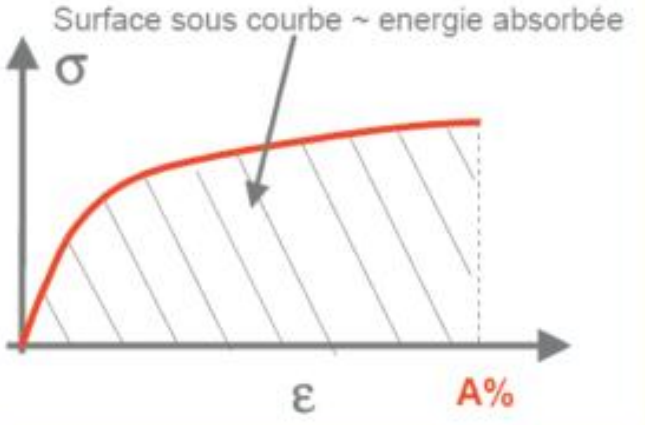
Mesure d'absorption d'énergie

Sans être exhaustifs, relevons quelques excellentes raisons, techniques et économiques, de choisir ce matériau dans ce domaine d'utilisation :

1) L'inox présente des rapports de rigidité (E/p) et de résistance spécifiques (R_e/p) très favorables, qui, malgré une densité 3 fois supérieure à celle de l'aluminium, permettent des allègements de structures. Des carrosseries de voitures ferroviaires plus légères consomment moins d'énergie lors de l'accélération et la décélération - un atout particulièrement évident pour les trains régionaux ou urbains à arrêts fréquents.

2) L'inox présente une capacité d'absorption de l'énergie élevée lors des déformations plastiques, telles qu'il peut s'en produire lors de collisions. Cette énergie est proportionnelle au produit R_m x A (charge de rupture multipliée par allongement). Ceci est valable pour les austénitiques, comme le tableau le démontre,

Matériau	R_m (MPa)	A%	R_m x A
Inox aust.	670	50	33500
Inox ferr.	500	26	13000
Acier C	420	25	10500
Alu recuit	90	42	4000



mais aussi pour les ferritiques très supérieurs à l'aluminium. D'autre part, les inox et particulièrement les austénitiques peuvent

subir un durcissement par écrouissage. Ce phénomène est d'autant plus prononcé que la vitesse de déformation est élevée (comme dans les crashs).
Grâce à ces deux caractéristiques essentielles (rigidité et capacité d'absorption de l'énergie), l'inox contribue à la robustesse et à la fiabilité des véhicules, et donc à la sécurité des personnes transportées

3) en termes économiques: la résistance à la corrosion de l'inox évite de lourds frais de maintenance puisque les wagons, rames et bus conservent leur aspect, ne requièrent rien de plus qu'un entretien courant et connaissent une durée d'exploitation record.

4) en termes d'agrément pour tous : des voitures durablement belles, agréables à l'œil, propres et en bon état, en un mot esthétiques, font partie de la qualité de vie au quotidien, valeur montante dans l'esprit de nos contemporains.

La mise en oeuvre de l'inox

Pour une juste évaluation de l'inox, il a été rappelé au cours de ces séminaires que, contrairement aux idées reçues, sa mise en œuvre, et son aptitude au soudage en particulier, ne demandent qu'une connaissance juste et une application rigoureuse des règles de l'art. A ces conditions, l'inox tient toutes ses promesses.

Le profilage des feuillards inox par exemple, permet dès la conception, des réductions en coûts de production, par exemple en évitant des assemblages soudés de sous-sections en forme de C et/ ou de U.

Image - Welser Profile (Autriche)

De plus, le profilage constitue une excellente façon de combiner plusieurs fonctions en un seul profilé : acheminement de câbles, refroidissement, fixation…

Comme dans toute opération de soudage, il faut en fonction des nuances choisies (l'austénitique EN 1.4318 ou le ferritique EN 1.4003 sont les plus courantes), bien sélectionner les produits d'apport, le procédé et les conditions, afin de concilier bonne soudabilité opératoire et productivité économique, tout en évitant les problèmes métallurgiques.

Et maintenant?

Un certain nombre des nuances proposées, ainsi que leurs caractéristiques, sont connues et utilisées depuis des décennies, mais les technologies de mise en oeuvre étant en constante évolution, il est indispensable d'échanger en permanence avec les constructeurs pour mieux adapter l'offre. Par exemple, les inox à l'état écroui, qui permettent des gains de poids considérables, sont une solution à faire connaître plus largement. De même, dans un contexte de grande volatilité des prix des éléments d'alliage tels que le nickel, l'exploitation des propriétés des aciers inoxydables ferritiques (gamme KARA d'ArcelorMittal) apparaît comme une alternative porteuse d'avenir, comme en témoignent ses débuts prometteurs. Le développement de ces deux pistes pourra réellement contribuer à la réduction des coûts de fabrication et de maintenance ainsi que de la consommation d'énergie du matériel roulant des transports collectifs, tout en améliorant notablement leur durée de vie.

(1) Acerinox (Espagne), ArcelorMittal Stainless Belgium (Belgique), Centro Sviluppo Materiali (Italie), Euro Inox (Belgique), OCAS (Belgique), Outokumpu (Finlande) et VTT (Finlande) en coopération avec l'université de technologie de Helsinki (Finlande).

(2) "Stainless steels in bus constructions" (Stainless Steel Bus: contract 7210-PR-176) et "Development of lightweight train and metro cars by using ultra high strength stainless steels" (DOLTRAC: contract 7210-PR-363).

(3) Le manuel INSAPTRANS est disponible en anglais sur demande à Mr Roeland Vliegen du site ArcelorMittal Genk .

APPENDIX 4

Seminarium „INSAPTRANS – zastoso-wanie stali odpornych na korozję w transporcie samo-chodowym”

Stal. Metale & Nowe Technologie 11/2008. p. 25

Seminarium „INSAPTRANS – zastosowanie stali odpornych na korozję w transporcie samochodowym”

7 października 2008 roku w Warszawie odbyło się organizowane prze Polską Unię Dystrybutorów Stali specjalistyczne seminarium INSAPTRANS poświęcone wykorzystaniu stali nierdzewnej w transporcie publicznym – w autobusach oraz w wagonach pociągów i metra.

Seminarium otworzył dyrektor PUDS Andrzej Ciepiela, przybliżając zebranym sytuację komunikacji publicznej w Polsce – zarys historyczny, i prognozy dla tego dużego sektora, który przewozi ok. 80% wszystkich pasażerów obsługiwanych przez branżę transportową w Polsce. Od połowy lat 80. spada stopień „użycia” komunikacji miejskiej. Obecnie liczba przewozów kształtuje się na poziomie 4 mld pasażerów rocznie – w rekordowym 1986 r. było to 9 mld. Dane dotyczące struktury wiekowej wykorzystywanych pojazdów wskazują na mały procent wymienialności starych maszyn na nowe.

Genezę i cele projektu INSPATRANS omówił Mika Sirén, przedstawiciel Fińskiego Badawczego Centrum Technicznego (VTT), będącego koordynatorem badań prowadzonych podczas projektu. Wytłumaczył pomysł przeprowadzenia badań oraz fakt dużego zainteresowania się nim europejskiego Funduszu Badawczego dla Węgla i Stali (RFCS). Mika Sirén wyjaśnił, że celem projektu było sprawdzenie zasadności stosowania (już od lat 70.) w Ameryce i Azji stali nierdzewnej w pojazdach transportu publicznego. Zespół INSAPTRANS postanowił zbadać możliwości wykorzystania stali nierdzewnych w przyszłości w Europie oraz korzyści wynikające z ich zastosowania pod względem ekonomicznym, bezpieczeństwa i oddziaływania na środowisko naturalne, a następnie rozpropagować je w podręczniku, w którym zostałyby zebrane wszystkie wyniki i wnioski. Ostatecznie INSAPTRANS został podzielony na dwa mniejsze projekty:

1. stale nierdzewne w konstrukcjach autobusów,
2. opracowanie lekkiej konstrukcji pociągów i wagonów metra z zastosowaniem stali nierdzewnych o wysokiej wytrzymałości.

W dalszej części seminarium prelegent omówił zasady konstruowania i projektowania lekkich konstrukcji ze stali odpornych na korozję, koncentrując się na konstrukcjach z profili zamkniętych i paneli typu „sandwich”. Prezentacja wyników testów zderzeniowych i zmęczeniowych wyraźnie wykazała lepszą wytrzymałość gatunków austenitycznych od ferrytycznych. – Zwłaszcza po crash testach na ramach profili zamkniętych najlepsze rezultaty miała stal 304SP – mówił Mika Sirén, podpierając się prezentowanymi w trakcie wystąpienia przykładami zastosowań.

Kolejny z zaproszonych gości omówił zagadnienie, które w największym stopniu wpływa na uzyskanie pożądanych rezultatów – właściwy dobór materiału i odpowiednio wykonany projekt. – Kalkulacje kosztów w cyklu życia wykazują, że redukcja wagi pojazdu zmniejsza zużycie paliwa i może skompensować wysokie początkowe koszty materiałowe – twierdził, powołując się na wyniki badań, Tero Taulavuori (Outokumpu, Tornio Research Center), członek grupy roboczej projektu INSAPTRANS. Zachęcał projektantów i operatorów obsługujących maszyny do wykonywania porównawczych kalkulacji kosztów na bazie własnych danych, dokonując tego przy każdym projekcie. Indywidualne podejście do projektu umożliwi optymalne zmniejszenie wagi obiektu (np. autobusu), za czym idzie mniejsze zużycie paliwa, które jest pozycją dominującą w kosztach cyklu życia pojazdu. Wymaga to od projektanta lub konstruktora znajomości właściwości mechanicznych i korozyjnych poszczególnych gatunków stali nierdzewnych, które również omówiono w tej części seminarium. Tero Taulavuori zapewniał, że zagwarantuje to kompensację ceny materiałów przy większych przebiegach.

Zebrani mogli również wysłuchać wystąpienia na temat gatunku stali nierdzewnej zwanej Dupleksem – o jego właściwościach i zastosowaniach opowiedział Paweł Chamczyk (dyrektor sprzedaży Outokumpu Sp. z o.o.), przedstawiając tę stal jako alternatywę dla gatunków austenitycznych.

Sponsorem seminarium INSAPTRANS było Outokumpu Oyj, a patronat medialny nad spotkaniem objęły: „STAL Metale & Nowe Technologie”, „Design Polska News”, „Stalowe Forum – Magazyn PUDS”, „Focus Nierdzewne”, Polska Izba Motoryzacji, www.4metal.pl. ❑

Źródło: PUDS

STAL 14

Prelegend seminarium INSPATRANS

APPENDIX 5

Seminar feedback questionnnaire

INSAPTRANS Seminar Evaluation Form

Your feedback is critical for future projects to ensure that the transport industry needs are met. We would appreciate if you could take a few minutes to share your opinion with us so we can serve you better.

Seminar/City/Country:_____

Date:_____

1. Practical information received:

Useless	1	2	3	4	5	Useful
Incomplete	1	2	3	4	5	Complete

2. Choice of topics presented:

Irrelevant	1	2	3	4	5	Relevant

3. The seminar was applicable to my job:

Agree	1	2	3	4	5	Disagree

4. Overall assessment of the lectures

Incompetent	1	2	3	4	5	Competent

5. I would be interested in attending a follow-up, more advanced workshop on the same subject

YES NO

6. In what areas was the seminar particular effective?

_____
_____
_____

7. What would be other topics in relation to stainless steel you would be interested in?

_____
_____
_____

Please return this form to the organizers at the end of the seminar. Thank you.

European Commission

EUR 24218 — Innovative stainless steel applications in transport vehicles

M. Siren, N. de Wispelaere, L. Rizzo, T. Pauly, A. Kosmac, T. Taulavuori, R. Sanchez, R. Vliegen, B. Van Hecke, J. Säynevirta, H. Hänningen

Luxembourg: Publications Office of the European Union

2010 — 52 pp. — 21 × 29.7 cm

Research Fund for Coal and Steel series

ISBN 978-92-79-14551-3

doi:10.2777/88587

ISSN 1018-5593

Price (excluding VAT) in Luxembourg: EUR 4