ALCAR™ - A MODEL FOR HORIZONTAL R&D CONSORTIA

H. Wayne Hayden', Gregory B. Barthold[2], Subodh K. Das[3]

[1]Oak Ridge National Laboratory, Metals & Ceramics Division, Oak Ridge, TN
[2]ASME-CRTD, Washington, DC
[3]ARCO Aluminum, Inc., Louisville, KY

Abstract

The ALCAR™ Consortium was created to develop a low cost, non-heat treatable automotive body sheet alloy. This paper will discuss the management aspects of organizing and running a horizontal consortium for competing companies to cooperate in conducting pre-competitive research and development involving the US Department of Energy, National Laboratories, Universities and industrial consultants.

Research sponsored by the U.S. Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Transportation Technologies, Lightweight Materials Program.

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Overview and Background

ALCAR™ is an innovative approach for conducting multi-company, pre-competitive research and development programs. ALCAR™ has been formed to create a partnership of aluminum producers, the American Society of Mechanical Engineers Center for Research and Technology Development (ASME/CRTD), the United States Department of Energy (USDOE), three USDOE National Laboratories, and a Technical Advisory Committee for conducting cooperative, pre-competitive research on the development of lower-cost, non-heat treated aluminum alloys for automotive sheet applications with strength, formability and surface appearance similar to current heat treated aluminum alloys under consideration. The effort has been supported by the USDOE, Office of Transportation Technology (OTT) through a three-year program with 50/50 cost share at a total program cost of $3 million.

Three companies producing aluminum flat-rolled sheet products; ARCO Aluminum, Inc., Century Aluminum (formerly Ravenswood Aluminum Corporation), and Commonwealth Aluminum have formed the ALCAR™ Consortium which is administrated by the ASME-CRTD. Lacking in-house R&D laboratory facilities, the Consortium established CRADA partnerships with ORNL, INEEL, and PNNL for conducting the pre-competitive R&D tasks. The Consortium established a seven-member Technical Advisory Committee composed of academic and industrial experts. Close coordination and cooperation has been established through ongoing frequent interactions between individual partners, regular conference telephone calls involving all partners, and quarterly meetings involving all partners held at the various partners' production and research sites. In order to maintain market focus, the consortium has had continuing interaction with major US automotive producers and suppliers.

During the period August 2-4, 1994, the U.S. Department of Energy (DOE), Energy Research Laboratory Technology Transfer Program; the Aluminum Association (AA); and the American Society of Mechanical Engineers (ASME) sponsored an Aluminum Industry Workshop in Colorado Springs, CO. The workshop was attended by representatives of 14 aluminum companies, the DOE and 11 DOE laboratories, the Environmental Protection Administration, the Federal Highway Administration. the Air Force, and the National Institute of Standards and Technology.

The objective of the workshop was to identify aluminum industry issues and government laboratory capabilities to address these issues with the hope that partnerships and consortia would be formed to pursue solutions. In addition, the workshop and exhibit attempted to introduce industry participants to all of the various government agency cooperative programs and national laboratory capabilities.

At the time of the workshop there were very few precedents of inter-company/government agency pre-competitive cooperative research programs in the aluminum industry. However, precedents for such approaches were being established in the automotive industry. Dr. Norman A. Gjostein of Ford Motor Company presented a description of the USCAR (United States Consortium for Automotive Research) and USAMP (United States Automotive Materials Partnership). His presentation provided the viewpoint and needs of the automotive industry, a major customer with increasing requirements for energy saving applications of aluminum.

During the second day of the workshop, four concurrent working groups were convened to discuss needs of the aluminum industry and capabilities of the national laboratories. The working groups were focused in the areas of:

- Computational Modeling and Validation
- Process Technology
- Environment Safety and Health
- Products, Markets, Properties

Research efforts focused on the future needs for automotive applications of aluminum were major recommendations from two of the working groups (Process Technology and Products, Markets, Products).

The development of a non-heat treated, 5xxx series alloy for automotive applications was proposed by Dr. John L. Mihelich of the Commonwealth Aluminum Company. Such a material was seen as a cost-effective, and more widely available alternative to the 6xxx series alloys which were the prime contenders for automotive sheet applications. Production of 6xxx sheet alloys requires the availability of continuous heat treating equipment. Such capabilities are costly from both capital and operating standpoints. Continuous heat treat capabilities are generally restricted to plants supplying the high cost, high strength heat treatable alloy sheet products required for critical aerospace applications.

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- All would like to establish increasing positions as suppliers to the automotive industry and/or parts suppliers to that industry.
- All are of the view that the combined capital and operating costs requirements for continuous heat treatment equipment make the 6xxx automotive sheet alloy market unsuitable for them.
- All of them lack the dedicated R&D laboratory facilities and staff resources for conducting a program of the magnitude anticipated for the development of a non-heat treated automotive sheet alloy.

After posting notice of the intent to form a consortium, the three companies entered in a formal agreement for the formation of a consortium on August 23, 1995. The ALCAR™ Consortium (Aluminum from Commonwealth, ARCO, and Ravenswood) was formed with the intent to cooperate in efforts with the DOE and DOE National Laboratories for carrying out pre-competitive research and development in the area of non-heat treatable aluminum alloys for automotive applications. Table I. presents a chart of roles and responsibilities for each of the participants in the

the advisory committee for technical services and attendance at regular quarterly progress meetings, purchase of outside services, legal services, etc.

With the assurance of funding support for efforts at the DOE laboratories through the DOE-OTT Light-Weight Materials Program, execution of Cooperative Research and Development Agreements (CRADA's) between the ALCAR™ Consortium and each of the three participating DOE National Laboratories was essential prior to the initiation of R&D activities. All CRADA agreements were in place on February 25, 1996.

Efforts for forming the proposed advisory committee of experts from both academia and industry were conducted concurrent with the CRADA agreement activities. These efforts were successfully completed and contracts for participation in the committee were executed with each of the members. The membership and affiliations of the advisory committee chaired by Prof. Amit Ghosh of the University of Michigan is shown in Table II. In addition to providing expert advice and guidance to the program, the members of the committee were asked to assist the consortium in establishing broad-based contacts with the automotive industry and its suppliers.

Table Il. ALCAR™ Technical Advisory Group

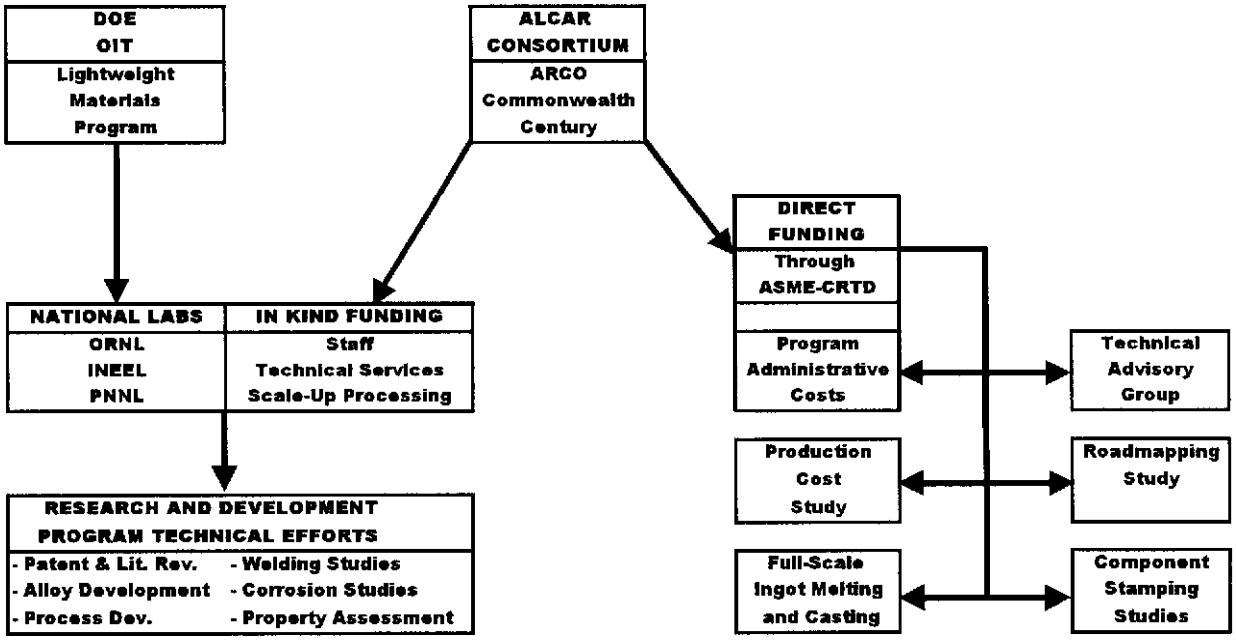
Name	Affiliation
University	
Prof. Amit Ghosh, Chairman	University of Michigan
Prof. Charlie Brooks	University of Tennessee
Prof. Henry R. Piehler	Carnegie Mellon University
Prof. Robert H. Wagoner	Ohio State University
Industrial	
Dr. Norman A. Gjostein	Consultant (Retired Ford Motor Co.)
Dr. Inge Hansson	Consultant (Retired ALCAN)
John L. Mihelich	Consultant (Retired Commonwealth Aluminum)

With the completion all of the above formalities, R&D activities were initiated in a kick-off meeting at ORNL on March 1, 1996. Figure 1. shows the flow of funding from both the DOE-OTT Lightweight Materials Program and the commercial companies in the consortium.

R&D Experimental Program

Efforts for the development of a non-heat treatable sheet alloy for automotive applications were driven by several factors:

- Automotive down-weighting will require increased usage of aluminum sheet products.
- The heat treatable 6xxx alloys, which are now preferred for automotive sheet applications based on their strength, formability, dent resistance, and surface appearance, require continuous heat treating process capabilities.


DOE
OIT
Lightweight Materials Program
ALCAR CONSORTIUM
ARCO
Commonwealth
Century
DIRECT FUNDING
Through ASME-CRTD
NATIONAL LABS
ORNL
INEEL
PNNL
IN KIND FUNDING
Staff
Technical Services
Scale-Up Processing
Program Administrative Costs
Technical Advisory Group
Production Cost Study
Roadmapping Study
Full-Scale Ingot Melting and Casting
Component Stamping Studies
RESEARCH AND DEVELOPMENT PROGRAM TECHNICAL EFFORTS
- Patent & Lit. Rev.
- Alloy Development
- Process Dev.
- Welding Studies
- Corrosion Studies
- Property Assessment

studies of all experimental and baseline materials was established. This included microstructural evaluations, mechanical testing, surface appearance, weldability, **and** stress corrosion.

A key question **from** the projected automotive industry customers has been magnitude of cost savings that could be projected for an NHT versus HT alloy. To address this question, the consortium funded a cost modeling study by Prof. Frank Field of MIT. The study considered both variable and fixed operating costs and investment-related financial costs. The results indicated a potential for at least 10% lower costs for the NHT alloy.

On the basis of the results on the experimental materials, two experimental alloy compositions, a commercial baseline alloy, and a range of processing procedures were

Scale-Up Studies

All scale-up studies were supported through direct-funding contributions made by the commercial consortium partners. The following efforts have been completed and/or are scheduled for completion:

- Two experimental alloy compositions and a baseline alloy have been selected for scale-up studies.
- Consortium-funded melting and casting of commercial-size DC cast ingots have been completed under contract with the Reynolds Metals R&D foundry.
- All ingots have been successfully hot rolled to 0.118” coil. Samples of the hot rolled coils will be used for stamping studies for automotive structural applications.
- Parts of the hot rolled coil from all ingots have been cold rolled to 0.047” 0.039” for inner and outer panel stamping tests.
- Roller leveling and side trimming of all gages has been completed.
- Samples of all coil products have been cut to lengths requested by the commercial stampers interested in evaluating the material.
- Cut-to-length samples have been finish annealed and shipped for stamping trials and stamped component evaluations.
- Laboratory assessments of strength, ductility, formability, weldability, and corrosion resistance of all finished gages are underway.
- Forming trials by commercial stampers are scheduled.

Conclusions

1. Automotive use of the NHT alloys developed through the program will hinge on the results of the stamping trials that are underway.

2. Commercialization of the alloys developed by the program rests with the individual efforts of each of the commercial consortium members

3. All ALCAR™ partners share the view that the Consortium has been a successful method for the accomplishment of the specific program objectives.

4. In the broader sense, it is believed that the ALCAR™ approach is a general model for competing companies to cooperate in carrying out pre-competitive R&D programs.