IBC Advanced Alloys

Nuclear Fuels Initiative

Increasing Efficiency and Safety

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1 Introduction

Reliance on nuclear power sources is increasing (Figure 1). Nuclear power plants can provide power on the scale required to meet ever increasing demand, and can do so without emitting any greenhouse gases. While renewable sources of power continue to see increased adoption, they lack the proven track record of nuclear sources and are generally still more expensive. The biggest issues facing the nuclear industry today are perceived safety as well as the need to continue to decrease operating costs. IBC Advanced Alloys (IBC) has been working to aid and fund research being conducted at Purdue and Texas A&M Universities in order to both increase safety margins as well as decrease operating costs through the improvement of nuclear fuel.

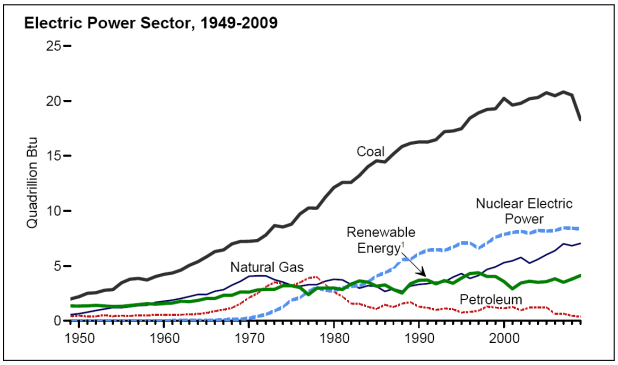

Figure 1: U.S. dependence on nuclear power sources is growing. Increased focus on the carbon emissions of power sources places carbon-free nuclear power in an ideal position for growth. (Source: U.S. Energy Information Administration)

2 New Fuel, Big Benefits

Initial research is showing that a newly developed nuclear fuel employing beryllium oxide additions features a cooler temperature than conventional fuels. The surface temperature of the fuel remains the same, while the centerline temperature is significantly lowered; resulting in a lower overall temperature for the fuel. This new fuel can therefore be operated at a lower temperature, without sacrificing power output. This development suggests that significant safety, environmental and economic benefits could be realized. Results thus far have been so encouraging that preliminary patents have been filed and the nuclear power sector is beginning to take notice.

Nuclear power is safe and reliable. Continued efforts must be made however to assuage understandable public fears which stem from nuclear power's unconventional nature. Traditional power sources can be turned off by effectively flipping a switch, after which heat, or power, stops quickly. Turning off a car's engine, for example, happens in a second or two. When a nuclear reactor is shut down, it continues to produce heat and power for some time afterwards. This new beryllium oxide containing fuel operates at a lower temperature, providing an increased response window in the event of an operational upset, which directly increases safety. While current fuels allow for commendable safety margins, any increases in safety can only further bolster public confidence in the industry.

The new fuel being developed features improved efficiency as compared with tradition nuclear fuel. This results in both an economic bonus and decreased environmental impact, as less uranium is required to produce the same power output. From an economic standpoint, fuel fabricators are expressing that they

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believe that this fuel will lead to cost savings for utility operators through decreased fuel costs. This is achieved through increased fuel performance which allows higher burn up, while reducing pellet cracking.

On the environmental side, it is believed that this new fuel will reduce fuel consumption by up to 4%, decreasing the rate at which it needs to be mined. Furthermore, this decreased consumption means that current reserves will last longer. A 4% reduction in current consumption would allow current reserves to power nine more nuclear reactors for 18 months.

3 Conclusion

Research being carried out at Purdue and Texas A&M Universities, funded and assisted by IBC Advanced Alloys, is yielding results which suggest that substantial safety, environmental and economic gains can be had through the introduction of BeO to the fuel. These efficiency gains could directly lead to decreased operating and fuel costs while increasing how long current uranium reserves will last. Moving forward, the next step is for this fuel to be tested at the U.S. Department of Energy's Advanced Test Reactor. This testing will provide concrete experimental data to validate the research completed thus far.