Council for LAB/LAS Environmental Research

ENVIRONMENTAL AND OTHER BENEFITS OF REPLACING ABS WITH LAS

There are two types of alkylbenzene sulfonates, ABS (branched alkylbenzene sulfonate) and LAS (linear alkylbenzene sulfonate). LAS had not been discovered when ABS was first introduced as a detergent surfactant in the late 1940s. While ABS has served consumers well, foam-related environmental problems began to appear in surface waters, groundwater, drinking water and in wastewater treatment plants. Investigation of these problems led to the discovery that ABS is resistant to biodegradation.[1,2,3] This resistance caused ABS to be known as non-biodegradable or a "hard detergent." LAS is known as biodegradable or a "soft detergent" because it quickly and completely biodegrades[2,3,4] and does not cause such environmental problems.

Environmental Benefits

As ABS was replaced with LAS beginning in the mid-1960s, extensive data, compiled in the book by R.D. Switzer[5], have confirmed the positive environmental effects. Among the well-documented examples:

United States: Surfactant concentrations in river waters dramatically decreased. The Illinois River at Peoria, Illinois, was highly polluted because of sewage and industrial plant effluents and storm water runoff from the greater Chicago area. From 1959 to 1965, the average MBAS (Methylene Blue Active Substance) concentration in the river was 0.54 parts per million (ppm). The MBAS test measures anionic surfactants (including LAS and ABS) and related anionic substances. These substances generally affect the taste of water and cause foaming at concentrations above 0.5 ppm. Consequently, the U.S. and other countries adopted standards for water quality of MBAS < 0.5 ppm. In the year following the conversion to LAS, the average MBAS value dropped to 0.22 ppm. By the spring of 1968, it had dropped even lower, averaging 0.05 ppm. In addition, analytical work showed that only 20 percent of the MBAS present was actually LAS.

A U.S. monitoring study of 50 river sites directly below wastewater treatment plants showed that the average LAS concentration was 0.035 ppm.[6] Furthermore, 90% of over 500,000 U.S. river miles in the U.S. have less than 0.004 ppm LAS.

England: When ABS was replaced with LAS in England, the surfactant concentration in river waters dropped by a factor of five. By 1966, surfactant levels had reached the lower limits of analytical detection. Today they are almost certainly lower. These changes occurred even though

the volume of detergents used, and therefore the amount entering the environment, had greatly increased.

Germany: From 1958 to 1964, MBAS residues in surface waters of the Rhine River basin increased constantly, paralleling the rapid increase in ABS consumption. The conversion to LAS in 1964 resulted in the immediate reduction of MBAS levels. Average MBAS concentrations continued to drop until pre-1958 levels were observed by the late 1970's. This overall reduction occurred despite a population increase of approximately 6 million people and a two-fold increase in detergent consumption over 1958 levels. From 1978 to 1987 the MBAS levels dropped to below 0.05 ppm. LAS specific analyses suggest that only about 0.01 ppm LAS is currently present in the Rhine River.

Japan: Similar results were observed in Japan. One example is that of the Tama River, which passes through heavily populated areas and receives large quantities of untreated domestic sewage. Even though the levels of organic pollutants in the river had reached the 8-10 ppm BOD level by the early 1980's, the yearly average MBAS residues had steadily decreased from a high of about 2.5 ppm in 1968 to 0.3 ppm in 1981 as a result of the use of LAS.

Thailand: In July-August 1983, the average MBAS residual over the 10-48 kilometer zone of the Chao Phraya River was 0.34 ppm. After switching to LAS, the average value over the same zone had decreased by 72 percent to 0.095 ppm by July of 1984.

Thus while there is extensive evidence that ABS causes environmental problems, there is now also overwhelming evidence that these problems are solved by changing to the use of LAS. This remains true regardless of geographical location, climate or environmental conditions.

Processing

The same plant process units, transfer and storage equipment, and similar operating conditions can be used for LAS as is used for ABS. No new plant investment or other significant changes are required in switching to the biodegradable LAS.

Performance Advantages

Both the cleaning power and the foam properties of LAS are equal or superior to ABS under most washing conditions. These performance advantages offer the detergent manufacturer possibilities of reducing the level of active ingredient and/or phosphate in the detergent product without sacrificing performance. (The actual amount of these reductions will depend, of course, on the particular formulation and the local washing conditions.) The detergency performance advantage of LAS over ABS is due to two factors. First the carbon distribution of LAS is at the optimum for

performance (C_{12} average). This is not the case for ABS which gives optimum performance at C_{13} average. Second, LAS is less sensitive to water hardness than ABS in, for example, Latin American washing conditions.[7] This greater cleaning property of LAS offers the detergent formulator possibilities for either a superior cleaning product or for surfactant and phosphate reductions in the detergent product when changing from ABS to LAS.

Conclusion

The change for ABS to LAS detergents has not only eliminated the environmental problem of non-biodegradability, but has given manufacturers and consumers a superior product with performance benefits. This has been thoroughly documented in countries throughout the world that have changed from ABS to LAS. As a result, LAS has become the leading detergent active ingredient in the world.

Key References

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