Laser-induced breakdown spectroscopy (LIBS) is an optical atomic spectroscopic technique which utilizes a laser for vaporization, atomization, ionization, and excitation of a sample [1]. A high powered laser pulses focused on the sample by means of a lens are used for plasma formation. The light emitted from ionized and neutral atoms in a plasma is collected by suitable optics and detected by a spectrograph. LIBS is a very suitable technique for the development of portable sensors and the application of this technique for the determination of environmental pollutants is increasing [2].

In this study, a continuous flow hydride generation laser-induced breakdown spectroscopic system [3], HG-LIBS, for the determination of lead and germanium in aqueous environments is described. Optimization of instrumental parameters like delay time, gate time, laser energy and also chemical parameters such as NaBH₄ and HCl concentration, flow rate, carrier gas and sample flow rate was performed under both nitrogen and argon atmosphere for the analysis of Pb and Ge. NaBH₄ solutions with concentrations of 1.0% (w/v) and 0.2% (w/v) were determined to be the optimum concentrations for the analysis of Pb and Ge, respectively. Optimum HCl concentrations were determined to be 2.5% (v/v), for the analysis of lead and 1.0% (v/v) for the analysis of germanium. Based on three times standard deviation of the background, a detection limit of 1.3 mg/L has been calculated from standard Pb samples using 405.8 nm line, under nitrogen environment. A detection limit of 0.2 mg/L was calculated for germanium by utilizing the resonance line at 265.1 nm under argon atmosphere. HG-LIBS method exhibited enhancement in detection limits, especially for Pb, two orders of magnitude enhancement was obtained compared to direct liquid analysis by LIBS. The applicability of the HG-LIBS system for the determination of Pb and Ge in aqueous environments has also been tested on several real water samples including tap water, drinking water and river water standard (SLRS-4).

Calculated detection limits for Pb and Ge are at low ppm (mg/L) level and are still higher than other atomic spectrometric detectors that utilize hydride generation as a sample introduction technique. However, the proposed system is suitable to be used as a portable LIBS sensor for real time continuous monitoring of pollutants in aqueous environments.

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KEYWORDS: hydride generation, laser-induced breakdown spectroscopy

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