Compact, Lightweight Servo-Controllable Brakes

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Compact, lightweight servo-controllable brakes capable of high torques are being developed for incorporation into robot joints. A brake of this type is based partly on the capstan effect of tension elements, which is described by the well-known equation

$$T_h / T_l = e^{\mu\beta},$$

where T_h is the higher tension at one end and T_l is the lower tension at the other end of a rope, belt, chain, or other tension element that is wrapped around a capstan so as not to slip; β is the total wrap angle in radians; and μ is the coefficient of friction between the capstan and the tension element. For example, a tension-multiplication factor of the order of 10^6 can be achieved by wrapping several turns of steel wire around a steel capstan. Heretofore, the capstan effect has been exploited in wound-spring clutches that operate in an on-or-off fashion. In a brake of the type under development, a controllable intermediate state of torque is reached through on/off switching at a high frequency.

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In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to MSC-23389-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

Automated Desalting Apparatus

By purifying field samples, this technology can be used for monitoring of water quality for applications in chemical, manufacturing, and farming industries.

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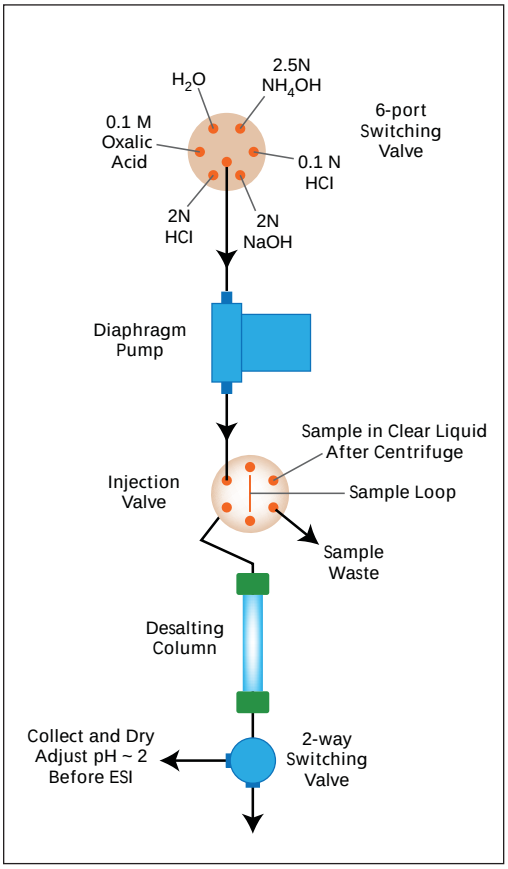
Because salt and metals can mask the signature of a variety of organic molecules (like amino acids) in any given sample, an automated system to purify complex field samples has been created for the analytical techniques of electrospray ionization/mass spectroscopy (ESI/MS), capillary electrophoresis (CE), and biological assays where unique identification requires at least some processing of complex samples. This development allows for automated sample preparation in the laboratory and analysis of complex samples in the field with multiple types of analytical instruments.

Rather than using tedious, exacting protocols for desalting samples by hand, this innovation, called the Automated Sample Processing System (ASPS), takes analytes that have been extracted through high-temperature solvent extraction and introduces them into the desalting column. After 20 minutes, the eluent is produced. This clear liquid can then be directly analyzed by the techniques listed above. The current apparatus including the computer and power supplies is sturdy, has an approximate mass of 10 kg, and a volume of about 20×20×20 cm, and is undergoing further miniaturization.



The **Automated Desalting Apparatus** includes two mutliport valves, a diaphragm valve, and an ion exchange column. Six different solvents are required to both process the sample and condition the column before and after processing.

This system currently targets amino acids. For these molecules, a slurry of 1 g cation exchange resin in deionized water is packed into a column of the apparatus. Initial generation of the resin is done by flowing sequentially 2–3 bed volumes of 2N NaOH and 2N HCl (1 mL each) to rinse the resin, followed by ≈5 mL of deionized water. This makes the pH of the resin near neutral, and eliminates cross sample contamination. Afterward, 2–3 mL of extracted sample is then loaded into the column onto the top of the resin bed. Because the column is packed tightly, the sample can be applied without disturbing the resin bed. This is a vital step needed to ensure that the analytes adhere to the resin.

After the sample is drained, oxalic acid (1 mL, pH 1.6-1.8, adjusted with NH_4OH) is pumped into the column. Oxalic acid works as a chelating reagent to bring out metal ions, such as calcium and iron, which would otherwise interfere with amino acid analysis. After oxalic acid, 1 mL 0.01 N HCl and 1 mL deionized water is used to sequentially rinse the resin. Finally, the amino acids attached to the resin, and the analytes are eluted using 2.5 M NH_4OH (1 mL), and the NH_4OH eluent is collected in a vial for analysis.