

# **J.P. Giroud**

## **Statement of Qualifications**

### **Landfills**

---

Dr. J.P. Giroud is certainly one of the engineers who had the deepest influence on modern landfill design. Dr. Giroud, considered the “father of geosynthetic liner systems” by *Waste Age* magazine, has developed many of the methods used for the design of geosynthetic liner systems for landfills such as: method for the determination of the rate of leakage through liners, stability analysis of liner systems on slopes, liner anchor trench design, leachate collection system design, leakage detection system design, design of liner systems over weak foundations, design of geotextile filters, evaluation of geomembrane liner uplift by wind. He received the International Geosynthetics Society Award for the design method he developed for the evaluation of leakage through liners; this method has now been incorporated in the HELP model for landfill design of the U.S. Environmental Protection Agency (USEPA). The design methods developed by Dr. Giroud for liners have been published in more than 60 papers and are used worldwide.

Dr. Giroud has originated innovative applications such as: the protection of geomembranes using geotextiles (1971), the double geomembrane liner with granular leakage detection layer (1974), and the double geomembrane liner with geosynthetic leakage detection layer, using a geonet (1980). He played a key role in the development of the use of geonets and geocomposite drainage systems in landfills. Dr. Giroud is also recognized for his pioneering work in construction quality assurance of liner systems.

Dr. Giroud has unique experience in performing forensic analyses and performance evaluation of landfills. He has performed more than 15 of these forensic analyses and performance evaluations, and has presented several keynote lectures on the subject. Also, Dr. Giroud is currently working on a 1000-page book on the subject.

Dr. Giroud has actively participated in the development of regulations for landfill liners. He was a consultant to the USEPA on the agency’s Liner Leak Detection Rule, Double-Liner Rule, and the related technical background documents. He also was a member of the task force developing the landfill rules for the Florida Department of Environmental Protection; his role in the task force was to develop a rationale for the liner system regulations. Dr. Giroud has also been asked on numerous occasions to develop “equivalency demonstrations” to show that an alternate solution for a liner system is equivalent to the liner system prescribed by regulations. Dr. Giroud has written several papers on liner system comparison and equivalency demonstrations, and he is the lead author of a paper that establishes the methodology for equivalency demonstrations for leachate collection systems.

JP GIROUD, SOQ LANDFILLS, 2005.06.30

Dr. Giroud has extensive experience in landfill design and construction. He has designed, or conducted a performance analysis for, more than 100 liner systems. He has participated in the design of several major landfills and low-level radioactive waste disposal facilities (in Alabama, California, Delaware, Florida, Illinois, Kansas, Louisiana, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Puerto Rico, Texas, Canada [Alberta, Ontario, Quebec], France, etc.). He has participated in performance analyses and forensic analyses of 15 landfills (Maine (2), Illinois, California (3), South Carolina, Ohio, New York (4), New Jersey, Portugal, Colombia). He also participated in one of the very few full-scale tests ever performed to evaluate the stability of the cover system of a major landfill (Connecticut).

Dr. Giroud has extensive experience in teaching courses on landfill design and liner systems: he has taught more than 50 courses on these subjects for the USEPA, Region 4 of EPA, the Florida Department of Environmental Protection, the U.S. Bureau of Reclamation, the Association of State Dam Safety Officials, the Industrial Fabrics Association International, the Swedish Geotechnical Institute, and many other organizations. Recently, Dr. Giroud has been the senior technical advisor for the videotape “Geosynthetics in Landfills” co-sponsored by the International Geosynthetics Society and the American Society of Civil Engineers.

Dr. Giroud co-chaired and presented the opening lecture at the session on construction quality assurance at the Fourth International Landfill Symposium (Sardinia 1993). Dr. Giroud is a member of the International Advisory Board for the International Landfill Symposium (1993, 1995, 1997, 1999, 2001, 2003). Dr. Giroud presented the keynote address on a comparison of filters used in landfills and other applications at the International Conference on Filters, GeoFilters '96 (Montreal, Canada 1996). In 2002, Dr. Giroud chaired the session on Geomembranes for Landfills at the International Conference on Geosynthetics. Dr. Giroud has been invited to present the prestigious Mercer Lecture series in 2005. The lecture, on “Contribution of geosynthetics to the geotechnical aspects of waste and liquid containment”, will be presented in Japan, in South Africa, and at the opening session of the International Landfill Symposium, in Sardinia.

## **Design and Innovative Practice on Liner Systems**

As a researcher, Dr. Giroud developed many methods of design for the use of geosynthetics. Design methods related to liner systems developed by Dr. Giroud include:

- Geotextile filter criteria.
- Design method and charts for the determination of stresses and strains in geosynthetics caused by a localized subsidence of the supporting ground or waste.

JP GIROUD, SOQ LANDFILLS, 2005.06.30

- Stability and differential movements of earth and concrete covers on geomembrane - geotextile - geonet systems.
- Design of drainage layers for leachate collection and leakage detection in waste disposal facilities.
- Evaluation of rate of leakage through liners.

Dr. Giroud is the principal author of three special issues of *Geosynthetics International*: “Design of Geomembrane Applications” (1995, 285 pages), “Control of Liquid Migration Using Geosynthetics Liner Systems” (1997, 251 pages), and “Liquid Collection Systems” (2000, 320 pages). These three volumes can be considered as the state of the art of liner system design. In particular, these three volumes present the detailed methodology for liner system performance evaluation.

As a practicing engineer, Dr. Giroud developed the double liner concept, which he presented in a paper in 1973. He used a double liner in a project constructed in 1974, which has performed well ever since. Applications related to liner systems originated by Dr. Giroud include:

- First use of a geotextile associated with a geomembrane (1971).
- First use of a double geomembrane liner (1974).
- First use of a geonet associated with two geomembranes to form an entirely geosynthetic double liner system (1980).

In addition, Dr. Giroud has been instrumental in the development of the use of geonets and geocomposite drainage systems in landfills in the United States and in the acceptance of this technique by the U.S. Environmental Protection Agency (EPA) (1984-1985).

Representative projects include:

- Design, geomembrane selection and quality assurance of NIES hazardous waste landfill, Wichita, Kansas (1982-83).
- Design of lining system for a hazardous waste landfill, Liberty County, Texas (1983).
- Design assistance, quality assurance, and full-scale slope stability of a hazardous waste landfill liner installation in Emelle, Alabama (1984).
- Assistance for design of a hazardous waste landfill closure including geomembrane, geonet and geotextile, Eastern Missouri (1984).
- Assistance for design of a hazardous waste landfill closure including passive gas ventilation, Missouri City, Missouri (1984).
- Review of design of a sanitary landfill, Fort Bend County, Texas (1985).
- Design assistance and quality assurance for a hazardous waste landfill, Baton Rouge, Louisiana (1985).

- Review of design of a proposed very large sanitary landfill, Morris County, New Jersey (1985).
- Review of design of a double lined hazardous waste landfill, Arlington, Oregon (1985).
- Lining system design for landfill in Broward County, Florida (1985-86).
- Assistance for design of a hazardous waste landfill, McIntosh, Alabama (1986).
- Review of the design of a sanitary landfill cover, Toronto, Canada (1986).
- Review of the design of a triple lining system for a hazardous waste landfill in Wright City, Missouri (1986).
- Review of the conceptual design of a hazardous waste landfill in Toronto, Canada (1986).
- Review of the design of a sanitary landfill lining system, Ottawa-Carleton, Canada (1986).
- Hazardous waste landfill design review and quality assurance plan, in Deer Park, Texas (1986).
- Conceptual design of lining system for a landfill in St. Lucie County, Florida (1986).
- Review of the conceptual design of the lining system for a municipal waste landfill in Foster County, Pennsylvania (1987).
- Review of the design of an ash landfill in Long Island, New York (1987).
- Review of liner material selection for a municipal waste landfill, Gloucester County, New Jersey (1988).
- Review of preliminary design of a municipal waste landfill, Cumberland, New Jersey (1988).
- Review of detailed design for a municipal waste landfill, West Palm Beach, Florida (1988).
- Conceptual design for the geomembrane liner system of a municipal waste landfill, Monroeville, Pennsylvania (1988).
- Preliminary design of the geomembrane liner system of a municipal waste landfill resting on existing waste, Long Island, New York (1988).
- Stability calculations for a geomembrane-lined ashfill, Long Island, New York (1988).
- Review of conceptual design of hazardous waste disposal landfill, Augusta, Michigan (1988).
- Evaluation of rate of leachate generation for a municipal landfill, Jacksonville, Florida (1988).
- Review of conceptual design and expert testimony for a municipal solid waste landfill, Edmonton, Canada (1989).
- Review of problems caused by vegetation growth to the geomembrane cap of a large municipal waste landfill, Fresh Kills, New York (1989).
- Design of geomembrane liner system for a large municipal solid waste landfill, Guaynabo, Puerto Rico (1991).
- Design of a removable geomembrane landfill cap for a landfill with waste mining/recycling, Collier County, Florida (1991).
- Review of landfill design, Livermore, California (1992).
- Technical assistance for the design of Lopez Canyon Landfill, California (1993).
- Evaluation of long-term performance of a geomembrane liner for a low-level radioactive waste repository, Martinsville, Illinois (1993).
- Evaluation of long-term performance of geomembrane liner and geosynthetic clay liner for a low level radioactive waste disposal facility, North Carolina (1994).

- Design assistance to Chem Nuclear Systems, Inc. for the development of “high-integrity vaults” for the storage of low-level radioactive waste (1994-1998).
- Design assistance for detailed design of a solid waste landfill, Calce, France (1995).
- Development of design criteria and design methodology, design assistance and design review for low-level radioactive waste disposal landfill, Fernald, Ohio (1996).
- Filter design assistance for two landfills, USA (1997).
- Design of 12 m deep excavation into waste to repair liner system in a landfill, Michigan (1997).
- Review of the design of an exposed geomembrane cap for a large municipal solid waste landfill in Sussex County, Delaware (1998).
- Review of wind uplift calculations for an exposed geomembrane cap at Sabine Parish Landfill, Louisiana (1999).
- Review of design of use of geosynthetic clay liner encapsulated between two geomembranes for two landfills, Keystone and Commonwealth (2001).
- Member of the design team of Lachenaie Landfill Northern Extension, Montreal, Canada (2001).
- Design assistance for Bryn Pica Landfill, UK (2001).
- Filter design review, Lewis Road Landfill (2002).
- Design assistance for the closure of a solid waste landfill, Guam (2004-2005).

## **Performance and Forensic Analyses**

Dr. Giroud has extensive experience in performing forensic analyses and providing expert testimony. He has performed approximately fifty forensic analyses and performance evaluations. His first participation in a court case dates back to 1962. The first failure analysis of a geomembrane lined facility by Dr. Giroud dates back to 1972. Since then, Dr. Giroud has investigated more than 30 failures of structures incorporating geosynthetics, including a number of geomembrane-lined landfills.

With his in-depth knowledge of geotechnical engineering and geosynthetics, Dr. Giroud is considered one of the foremost international authorities on the performance of geotechnical structures incorporating geosynthetics: keynote lecturer on geosynthetic failures at the conference “*Foundation of Success: Lessons Learned from Failures*” organized by the Colorado Section of the American Society of Civil Engineers (ASCE) (1992); keynote speaker on “*Lessons Learned from Failures Associated with Geosynthetics*” at the French Conference on Geosynthetics in Tours (France, 1993); keynote lecturer on “*Lessons Learned from Failures Associated with Geosynthetics*” at Geosynthetics ’99, the bi-annual conference of the North American Geosynthetics Society, held in Boston, USA, and author of the 66-page paper on the subject in the proceedings of the conference; keynote lecturer on “*Lessons Learned from Failures and Successes Associated with Geosynthetics*” at “Eurogeo 2”, the Second European Conference on Geosynthetics, held in Bologna, Italy, in 2000, and author of the 42-page paper on the subject in the proceedings of the conference. Also, Dr. Giroud is

a frequently invited lecturer on the performance of structures incorporating geosynthetics and lessons learned from failures: “Kersten Lecture”, University of Minnesota/Minnesota Geotechnical Society, 1999; “Jack Hilf Memorial Lecture” The University of Colorado/US Bureau of Reclamation, 1999; and “The Nete Lecture”, Three Gorges Dam, China, 2000. Dr. Giroud is currently working on a 1000-page book on failures associated with geosynthetics, and he is co-author of a 210-page report on “Waste Containment Systems: Problems and Lessons Learned” (1999) for the US EPA (to be released in 2002).

Dr. Giroud has worked in many parts of the world. In particular, he has performed forensic analyses or performance evaluations in various countries, such as Argentina, Jordan, Niger, France, the United States, etc. Furthermore, as President of the International Geosynthetics Society, or on other occasions, Dr. Giroud has chaired, or participated in, numerous international meetings and panels. As a result of this international experience, Dr. Giroud feels comfortable working everywhere in the world, and his authority and arbitration skills are instrumental in difficult situations, in particular when international participants are involved. Also, as a result of the work he has done for regulatory agencies (preparation of background documents to support regulations, report and manual preparation, training courses), Dr. Giroud is highly respected by representatives of governmental agencies, which is helpful in case problems linked to the performance of regulated facilities, such as landfills.

Examples of landfill performance evaluation and forensic analyses include:

- Review of monitoring data for a hazardous waste landfill, Peoria, Illinois (1989).
- Analysis of the failure of a liner system in a landfill (sideslope stability, leakage), Fulton County, New York (1989).
- Analysis of potential leakage out of a geomembrane-lined municipal landfill and potential ground water contamination, Azusa, California (1989).
- Analysis and remedial measures for liner system instability in a landfill, Babylon, New York (1990).
- Analysis of a waste slide and liner system failure in a hazardous waste landfill, Kettleman City, California (1990).
- Investigation of foundation soil, waste slide, and liner system failure in a landfill, Portugal (1995-1996).
- Expert testimony on the evaluation of the design of a waste disposal landfill, St. Etienne, Canada (1995-1996).
- Analysis of a very large waste slide in a landfill, Bogotá, Colombia (1997-1998).
- Performance evaluation of a landfill cap geomembrane liner with substandard seams, Clarkstown, New York (1999).
- Performance evaluation of a landfill cover system with defective drainage geocomposite, Buckeye, Ohio (2001).

## **Expert Testimony**

Dr. Giroud has personal experience in providing expert testimony at administrative and judicial hearings. Dr. Giroud has also presented project descriptions and design concepts at public information meetings. These hearings and meetings were related to siting or permitting of hazardous or municipal waste disposal facilities.

## **Experience with US EPA and Regulatory Agencies**

Dr. Giroud has worked extensively with the US Environmental Agency (USEPA) and other regulatory agencies, as indicated below:

- Preparation of “Guide Specifications for Geomembrane Installation in Hazardous Waste Disposal Facilities”, as part of a contract between the EPA and TRW (1983).
- Preparation of “Assessment of Synthetic Membrane Performance at Waste Disposal Facilities” for the USEPA (1984).
- Review of the “Permit Writer's Guidance Manual for Hazardous Waste Land Treatment, Storage, and Disposal Facilities”, as part of a contract between the EPA and GCA (1984).
- Participation in meetings with the US EPA for the revision of leachate collection and leakage detection rules to incorporate synthetic drainage layers (1984-1985).
- Review of “Design, Construction, Inspection, Maintenance and Repair of Leachate Collection and Cap Drainage Systems”, as part of a contract between the EPA and A.D. Little (1985). Subcontract through Peer Consultants.
- Review of “Construction Quality Assurance for Hazardous Waste Land Disposal Facilities”, as part of a contract between the EPA and the Research Triangle Institute (1985).
- Review of “Avoiding Failure of Leachate Collection and Cap Drainage Systems” for the USEPA (1986).
- Review of “Background Document: Bottom Liner Performance in Double-Lined Landfills and Surface Impoundments”, EPA/530-SW-87-013, April 1987, 301 p., Subcontract through NUS.
- Preparation (co-author) of the “Background Document: Proposed Liner and Leak Detection Rule”, EPA/530-SW-87-015, May 1987, 526 p., Subcontract through NUS.
- Review of “Background Document: Comparative Performance of Single-Liner and Double-Liner Systems”, October 1987, 76 p., Subcontract through NUS.
- Evaluation of Birchwood demolition debris landfill permit application for Rhode Island Department of Environmental Management (RIDEM) (1988).

- Participation in the Technical Advisory Task Force of the Florida Department of Environmental Regulations for the preparation of new landfill rules (1990-1992).
- Review of “Leakage Detection, Collection, and Removal System Flow Data from Operating Units — Technical Support for Proposed Liner/leak Detection System Rule”, for the USEPA (1991).
- Review of “Action Leakage Rates for Leak Detection Systems, Supplemental Background Document for the Final Double Liners and Leak Detection Systems Rule for Hazardous Waste Landfills, Waste Piles, and Surface Impoundments”, for the USEPA (1992).
- Participation in “Performance Criteria for Landfill Cover”, for the California Integrated Waste Management Board (1992-1993).
- Participation in the preparation of the national guidelines on geomembrane construction quality assurance for the French environmental regulatory agency, ADEME (1996).
- Co-author of a comprehensive survey of problems in landfills, titled “Waste Containment Systems: Problems and Lessons Learned” (1999), for the US EPA (to be released in 2002).

Also, Dr. Giroud has been a peer reviewer of the work by the GeoSyntec Consultants team that evaluated under contract for the USEPA monitoring data from more than a hundred landfill cells or liquid impoundments.

As a result of all this work J.P. Giroud is in a unique position to deal with regulatory agencies.

## **Quality Assurance of Liner System Installation**

Dr. Giroud became involved in quality assurance of liner system installation as early as 1980. The report “*Guide Specifications for Geomembrane Installation in Hazardous Waste Disposal Facilities*”, prepared by Giroud and Kastman in 1982 and published as part of a state-of-the-art report for the EPA, laid the foundations for modern geosynthetic quality assurance. Dr. Giroud also prepared a general quality assurance manual for the installation of geosynthetic liner systems for a major US waste management firm. Finally, Dr. Giroud was instrumental in forming, at GeoSyntec Consultants, a Quality Assurance Division which, from 1984 on, has been involved in more than 500 projects, totaling approximately 80 million square meters (875 million square feet) of geosynthetics. During the first years of operation of this division, Dr. Giroud participated personally in construction quality assurance field work. Typical landfill projects where Dr. Giroud was involved in quality assurance field work include, for example:

- Hazardous waste landfill, Wichita, Kansas (1983)
- Hazardous waste landfill, Emelle, Alabama (1984)

- Hazardous waste landfill, Arlington, Oregon (1985)
- Hazardous waste landfill, Baton Rouge, Louisiana (1986)
- Low-level radioactive waste disposal landfill, Fernald, Ohio (1996).

## **Training Courses on Landfills and Liner Systems**

Dr. Giroud has taught training courses on landfills and liner systems for the personnel of the EPA and state regulatory agencies. These include:

- Geomembrane Liners, Properties, Design and Installation in Landfills, presented in all 10 regions of USEPA (1983-1984).
- Permit Writer's Training Seminar on Synthetic Liners, presented to: EPA Region 4 in Atlanta, EPA Region 10 in Sacramento, EPA Region 3 in Philadelphia, EPA Region 2 in New York, and EPA Region 6 in Dallas (1985); EPA Region 7 in Kansas City, and EPA Region 5 in Chicago (1986).
- Permit Writer's Training Seminar on Landfill Covers, presented to: EPA Region 2 in Puerto Rico, EPA Region 10 in Sacramento, and EPA Region 5 in Chicago (1986).
- Course on liner systems in landfills in all 8 states of EPA Region 4 under contract with EPA Region 4 (1994).
- Every other year since 1992, Dr. Giroud teaches a landfill course sponsored by Florida DEP (in conjunction with the University of Florida).

In addition, Dr. Giroud teaches every year a short course on liner systems for landfills as part of the Landfill Course of the University of Wisconsin, Madison (from 1986).

## **Selected References of Publications Related to Landfills**

- Giroud, J.P., 1982, "Design of Geotextiles Associated with Geomembranes", *Proceedings of the Second International Conference on Geotextiles*, Vol. 1, Las Vegas, Aug 1982, pp. 37-42.
- Giroud, J.P. and Goldstein, J.S., 1982, "Geomembrane Liner Design", *Waste Age*, Vol. 13, No. 9, Sep 1982, pp. 27- 30.
- Giroud, J.P., 1984, "Geomembrane Liners: Accidents and Preventive Measures", *Proceedings of the Second International Symposium on "Plastic and Rubber Waterproofing in Civil Engineering"*, Vol. 1, Session 4, Liege, Belgium, Jun 1984, pp. 4.2.1-4.2.6.
- Giroud, J.P., 1984, "Impermeability: The Myth and a Rational Approach", *Proceedings of the International Conference on Geomembranes*, Vol. 1, Denver, CO, USA, Jun 1984, pp. 157-162.
- Giroud, J.P., and Ah-Line, C., 1984, "Design of Earth and Concrete Covers for Geomembranes", *Proceedings of the International Conference on Geomembranes*, Vol. 2, Denver, CO, USA, Jun 1984, pp. 487-492.

- Giroud, J.P. and Bonaparte, R., 1984, "Waterproofing and Drainage: Geomembranes and Synthetic Drainage Layers", *Proceedings of the Second International Symposium on Plastic and Rubber Waterproofing in Civil Engineering*, Vol. 1, Session 3A, Liege, Belgium, Jun 1984, pp. 3A.1.1-3A.1.6.
- Williams, N., Giroud, J.P., and Bonaparte, R., 1984, "Properties of Plastic Nets for Liquid and Gas Drainage Associated with Geomembranes", *Proceedings of the International Conference on Geomembranes*, Vol. 2, Denver, CO, USA, Jun 1984, pp. 399-404.
- Bonaparte, R., Williams, N., and Giroud, J.P., 1985, "Innovative Leachate Collection Systems for Hazardous Waste Containment Facilities", *Proceedings of the Geotechnical Fabrics Conference '85*, IFAI, Cincinnati, OH, Jun 1985, pp. 9-34.
- Giroud, J.P. and Fluet, J.E., Jr., 1986, "Quality Assurance of Geosynthetic Lining Systems", *Geotextiles and Geomembranes*, Vol. 3, No. 4, Elsevier, London, England, 1986, pp. 249-287.
- Bonaparte, R., Giroud, J.P., Wallace, R.B., Ah-Line, C., and Prillaman, J.G., 1987, "*Background Document on Proposed Liner and Leak Detection Rule*", EPA/530-SW-87-015, U.S. Environmental Protection Agency, Washington, DC, USA, May 1987, 526 p.
- Giroud, J.P., Bonaparte, R., Beech, J.F., and Gross, B.A., 1989, "Load-carrying Capacity of a Soil Layer Supported by a Geosynthetic Overlying a Void", *Proceedings of the International Geotechnical Symposium on Theory and Practice of Earth Reinforcement*, Yamanouchi, T., Miura, N., and Ochiai, H., Editors, Fukuoka- Kyushu, Japan, October 1988, pp. 185-190.
- Bonaparte, R., Giroud, J.P., and Gross, B.A., 1989, "Rates of Leakage through Landfill Liners", *Proceedings of Geosynthetics '89*, Vol. 1, IFAI, San Diego, CA, February 1989, pp. 18-29.
- Giroud, J.P. and Beech, J.F., 1989, "Stability of Soil Layers on Geosynthetic Lining Systems", *Proceedings of Geosynthetics '89*, Vol. 1, IFAI, San Diego, CA, February 1989, pp. 35-46.
- Giroud, J.P. and Cazzuffi, D.A., 1989, "Uses of Geosynthetics for Environmental Control", *Proceedings of the Twelfth International Conference on Soil Mechanics and Foundation Engineering*, Rio de Janeiro, August 1989, Vol. 5, pp. 3119-3125.
- Giroud, J.P. and Bonaparte, R., 1989, "Leakage through Liners Constructed with Geomembranes, Part I: Geomembrane Liners", *Geotextiles and Geomembranes*, Vol. 8, No. 1, 1989, pp. 27-67.
- Giroud, J.P. and Bonaparte, R., 1989, "Leakage through Liners Constructed with Geomembranes, Part II: Composite Liners", *Geotextiles and Geomembranes*, Vol. 8, No. 2, 1989, pp. 71-111.
- Giroud, J.P., Khatami, A., and Badu-Tweneboah, K., 1989, "Evaluation of the Rate of Leakage through Composite Liners", *Geotextiles and Geomembranes*, Vol. 8, No. 4, 1989, pp. 337-340.
- Giroud, J.P., 1990, "Protect the Geomembrane Cap!", *Waste Age*, (Landfills Issue) Vol. 21, No. 3, March 1990, pp. 58-60.
- Gross, B.A., Bonaparte, R., and Giroud, J.P., 1990, "Evaluation of Flow from Landfill Leakage Detection Layers", *Proceedings of the Fourth International Conference on Geotextiles, Geomembranes and Related Products*, Vol. 2, The Hague, The Netherlands, May 1990, pp. 481-486.
- Giroud, J.P., Swan, Jr., R.H., P.J. Richer, and P.R. Spooner, 1990, "Geosynthetic Landfill Cap: Laboratory and Field Tests, Design and Construction", *Proceedings of the Fourth International Conference on Geotextiles, Geomembranes and Related Products*, Vol. 2, The Hague, The Netherlands, May 1990, pp. 493-498.
- Giroud, J.P., Beech, J.F., and Khatami, A., 1990, "Stability of Solid Waste on Geosynthetic Lining Systems", *Proceedings of the Fourth International Conference on Geotextiles, Geomembranes and Related Products*, Vol. 2, The Hague, The Netherlands, May 1990, p. 526.

- Giroud, J.P., 1990, "Discussion of Geosynthetic Landfill Cap: Laboratory and Field Tests, Design and Construction", *Proceedings of the Fourth International Conference on Geotextiles, Geomembranes and Related Products*, Vol. 3, The Hague, May 1990, pp. 1097-1098.
- Giroud, J.P., 1990, "General Report on Waste Disposal", *Proceedings of the Fourth International Conference on Geotextiles, Geomembranes and Related Products*, Vol. 3, The Hague, The Netherlands, May 1990, p. 1205.
- Gross, B.A., Bonaparte, R., and Giroud, J.P., 1990, "Discussion of Evaluation of Flow from Landfill Leakage Detection Layers", *Proceedings of the Fourth International Conference on Geotextiles, Geomembranes and Related Products*, Vol. 3, The Hague, The Netherlands, May 1990, pp. 1095-1096.
- Giroud, J.P., Bonaparte, R., Beech, J.F., and Gross, B.A., 1990, "Design of Soil Layer-Geosynthetic Systems Overlying Voids", *Geotextiles and Geomembranes*, Vol. 9, No. 1, Elsevier, London, England, 1990, pp. 11-50.
- Giroud, J.P. and Peggs, I.D., 1990, "Geomembrane Construction Quality Assurance", *Waste Containment Systems: Construction, Regulation, and Performance*, Geotechnical Special Publication No. 26, ASCE, R. Bonaparte, Editor, November 1990, pp. 190-225.
- Cazzuffi, D. and Giroud, J.P., 1991, "I Geosintetici nei Sistemi di Impermeabilizzazione e Drenaggio delle Discariche Controllate" (Geosynthetics in Systems for Waterproofing and Drainage of Secure Landfills), *Atti delle Conferenze di Geotecnica di Torino - XV Ciclo - "La Ingegneria Geotecnica nella Salvaguardia e Recupero del Territorio"*, Torino, Italy, November 1991, 28 p. (in Italian)
- Giroud, J.P., Badu-Tweneboah, K., and Bonaparte, R., 1992, "Rate of Leakage Through a Composite Liner due to Geomembrane Defects", *Geotextiles and Geomembranes*, Vol. 11, No. 1, 1992, pp. 1-28.
- Giroud, J.P., and Morel, N., 1992, "Analysis of Geomembrane Wrinkles", *Geotextiles and Geomembranes*, Vol. 11, No. 3, 1992, pp. 255-276.
- Tisinger, L.G. and Giroud, J.P., 1993, "The Durability of HDPE Geomembranes", *Geotechnical Fabrics Report*, Vol. 11, No. 6, September 1993, pp. 4-8.
- Beech, J.F., Giroud, J.P., and Wallace, R.B., 1993, "Geosynthetics in Hazardous Waste Landfill, Baton Rouge, Louisiana, USA", *Geosynthetics Case Histories*, Raymond, G.P. and Giroud, J.P., Eds., ISSMFE, 1993, pp. 28-29.
- Tisinger, L.G. and Giroud, J.P., 1993, "The Durability of PVC Geomembranes", *Geotechnical Fabrics Report*, Vol. 11, No. 7, October 1993, pp. 12-16.
- Giroud, J.P. and Tisinger, L.G., 1993, "The Influence of Plasticizers on the Performance of PVC Geomembranes", *Geosynthetic Liner Systems: Innovations, Concerns and Designs*, Koerner, R.M. and Wilson-Fahmy, R.F., Eds., Proceedings of the 7th Symposium of the Geosynthetic Research Institute, Philadelphia, PA, USA, December 1993, pp. 169-196.
- Giroud, J.P., 1994, "North American Experience on Geosynthetics in Landfills", *L'Ingegnere e l'Architetto*, Vol. 1, No. 1-4, 1994, Proceedings of the 7th Italian Conference on Geosynthetics, held in Bologna, Italy, October 1993, pp. 69-72. (in English with Italian Abstract)
- Rowe, R.K. and Giroud, J.P., 1994, "Quality Assurance of Barrier Systems for Landfills", *IGS News*, Vol. 10, No. 1, March 1994, pp. 6-8.
- Giroud, J.P., Badu-Tweneboah, K., and Soderman, K.L., 1994, "Evaluation of Landfill Liners", *Proceedings of the 5th International Conference on Geotextiles, Geomembranes and Related Products*, Singapore, Sep 1994, Vol. 3, pp. 981-986.
- Giroud, J.P., Bonaparte, R., and Sembenelli, P., 1995, "Selection of Waste Containment Systems in Developing Countries", *Proceedings of the Fifth International Landfill Symposium*, Sardinia, Italy, October 1995, Vol. 2, pp. 149-157.

JP GIROUD, SOQ LANDFILLS, 2005.06.30

- Giroud, J.P., and Houlihan, M.F., 1995, "Design of Leachate Collection Layers", *Proceedings of the Fifth International Landfill Symposium*, Sardinia, Italy, October 1995, Vol. 2, pp. 613-640.
- Giroud, J.P., Pelte, T., and Bathurst, R.J., 1995, "Uplift of Geomembranes by Wind", *Geosynthetics International*, Vol. 2, No. 6, pp. 897-952. (Errata, 1997, Vol. 4, No. 2, pp. 187-207, and 1999, Vol. 6, No. 6, pp. 521-522.)
- Giroud, J.P., Williams, N.D., Pelte, T., and Beech, J.F., 1995, "Stability of Geosynthetic-Soil Layered Systems on Slopes", *Geosynthetics International*, Vol. 2, No. 6, pp. 1115-1148.
- Giroud, J.P., Bachus, R.C., and Bonaparte, R., 1995, "Influence of Water Flow on the Stability of Geosynthetic-Soil Layered Systems on Slopes", *Geosynthetics International*, Vol. 2, No. 6, pp. 1149-1180.
- Bonaparte, R., and Giroud, J.P., 1996, "Waste Containment Systems for Pollution Control: Part II-Hydraulic Design and Performance", Proceedings, NATO Advanced Study Institute Series, *Recent Advances in Ground-Water Pollution Control and Remediation*, Kluwer Academic Publishers, The Netherlands, pp. 437-478.
- Zornberg, J.G., and Giroud, J.P., 1997, "Uplift of Geomembranes by Wind - Extension of Equations", *Geosynthetics International*, Vol. 4, No. 2, pp.187-207. (Errata: 1999, Vol. 6, No. 6, pp. 521-522).
- Giroud, J.P., Gross, B.A., Bonaparte, R., and McKelvey, J.A., 1997, "Leachate Flow in Leakage Collection Layers Due to Defects in Geomembrane Liners", *Geosynthetics International*, Vol. 4, Nos. 3-4, pp. 215-292.
- Giroud, J.P., Khire, M.V., and Soderman, K.L., 1997, "Liquid Migration Through Defects in a Geomembrane Overlain and Underlain by Permeable Media", *Geosynthetics International*, Vol. 4, Nos. 3-4, pp. 293-321. (Errata, 1999, Vol.6, No. 1, p 69)
- Giroud, J.P., Khire, M.V., and McKelvey, J.A., 1997, "Rate of Leachate Migration Through a Defect in a Geomembrane Underlain by a Saturated Permeable Medium", *Geosynthetics International*, Vol. 4, Nos. 3-4, pp. 323-334.
- Giroud, J.P., 1997, "Equations for Calculating the Rate of Liquid Migration Through Composite Liners Due to Geomembrane Defects", *Geosynthetics International*, Vol. 4, Nos. 3-4, pp. 335-348.
- Giroud, J.P., King, T.D., Sanglerat, T.R., Hadj-Hamou, T., and Khire, M.V., 1997, "Rate of Liquid Migration Through Defects in a Geomembrane Placed on a Semi-Permeable Medium", *Geosynthetics International*, Vol. 4, Nos. 3-4, pp. 349-372.
- Giroud, J.P., Soderman, K.L., and Badu-Tweneboah, K., 1997, "Optimal Configuration of a Double Liner System Including a Geomembrane Liner and a Composite Liner", *Geosynthetics International*, Vol. 4, Nos. 3-4, pp. 373-389.
- Giroud, J.P., Badu-Tweneboah, K., and Soderman, K.L., 1997, "Comparison of Leachate Flow Through Compacted Clay Liners and Geosynthetic Clay Liners in Landfill Liner Systems", *Geosynthetics International*, Vol. 4, Nos. 3-4, pp. 391-431.
- Giroud, J.P., Rad, N.S., and McKelvey, J.A., 1997, "Evaluation of the Surface Area of a GCL Hydrated by Leachate Migrating Through Geomembrane Defects", *Geosynthetics International*, Vol. 4, Nos. 3-4, pp. 433-462.
- Badu-Tweneboah, K., Giroud, J.P., Carlson, D.S., and Schmertmann, G.R., 1997, "Discussion of 'Field Evaluation of Protective Covers for Landfill Geomembrane Liners Under Construction Loading'", *Geosynthetics International*, Vol. 4, No. 5, pp. 543-544.
- Matasovic, N., Kavazanjian, E., Jr., and Giroud, J.P., 1998, "Newmark Seismic Deformation Analysis for Geosynthetic Interfaces", *Geosynthetics International*, Special Issue on Geosynthetics in Earthquake Engineering Vol. 5, Nos. 1-2, pp. 237-264.

- Giroud, J.P., Houlihan, M.F., Bachus, R.C., and Qureshi, S., 1998, "Clogging Potential of Geosynthetic Leachate Collection Layers by Fine Particles from Soil Protective Layers", *Proceedings of the Sixth International Conference on Geosynthetics*, Vol. 1, Atlanta, Georgia, USA, March 1998, pp. 185-190.
- Gleason, M.H., Houlihan, M.F., and Giroud, J.P., 1998, "An Exposed Geomembrane Cover System for a Landfill", *Proceedings of the Sixth International Conference on Geosynthetics*, Vol. 1, Atlanta, Georgia, USA, March 1998, pp. 211-218.
- Giroud, J.P., Soderman, K.L., Khire, M.V., and Badu-Tweneboah, K., 1998, "New Developments in Landfill Liner Leakage Evaluation", *Proceedings of the Sixth International Conference on Geosynthetics*, Vol. 1, Atlanta, Georgia, USA, March 1998, pp. 261-268.
- Badu-Tweneboah, K., Giroud, J.P., Carlson, D.S., and Schmertmann, G.R., 1998, "Evaluation of the Effectiveness of Geomembrane Liner Protection", *Proceedings of the Sixth International Conference on Geosynthetics*, Vol. 1, Atlanta, Georgia, USA, March 1998, pp. 279-284.
- Matichard, Y., Pelte, T., et Giroud, J.P., 1998, "Démarche de Qualité pour la Mise en Oeuvre des Geosynthétiques", ADEME Editions, Angers, France, 1998, 87 p.
- Badu-Tweneboah, K., Tisinger, L.G., Giroud, J.P., and Smith, B.S., 1999, "Assessment of the Long-Term Performance of Polyethylene Geomembrane and Containers in a Low-Level Radioactive Waste Disposal Landfill", *Proceedings of Geosynthetics '99*, Boston, Massachusetts, USA, April 1999, IFAI, Vol. 2, pp. 1055-1070.
- Gleason, M.H., Germain, A.M., Vasuki, N.C., and Giroud, J.P., 1999, "Design and Construction of an Exposed Geomembrane Cover for a Solid Waste Landfill", *Proceedings of the Seventh International Landfill Symposium*, Sardinia, Italy, October 1999, Vol. 3, pp. 335-342.
- Hendron, D.M., Fernandez, G., Prommer, P.J., Giroud, J.P., and Orozco, L.F., 1999, "Investigation of the Cause of the 27 September 1997 Slope Failure at the Doña Juana Landfill", *Proceedings of the Seventh International Landfill Symposium*, Sardinia, Italy, October 1999, Vol. 3, pp. 545-554.
- Giroud, J.P., Gleason, M.H., and Zornberg, J.G., 1999, "Design of Geomembrane Anchorage Against Wind Action", *Geosynthetics International*, Vol. 6, No. 6, pp. 481-507.
- Gross, B.A., Bonaparte, R., and Giroud, J.P., 1999, "Waste Containment Systems: Problems and Lessons Learned," Appendix F in *Assessment and Recommendations for Optimal Performance of Waste Containment Systems*, R.M. Koerner, D.E. Daniel, and R. Bonaparte, U.S. Environmental Protection Agency, National Risk Management Research Laboratory, Cincinnati, OH, 1999.
- Giroud, J.P., Zornberg, J.G., and Zhao, A., 2000, "Hydraulic Design of Geosynthetic and Granular Liquid Collection Layers", *Geosynthetics International*, Special Issue on Liquid Collection Systems, Vol. 7, Nos. 4-6, pp. 285-380.
- Giroud, J.P., Zhao, A., and Bonaparte, R., 2000, "The Myth of Hydraulic Transmissivity Equivalency Between Geosynthetic and Granular Liquid Collection Layers", *Geosynthetics International*, Special Issue on Liquid Collection Systems, Vol. 7, Nos. 4-6, pp. 381-401.
- Giroud, J.P., Zornberg, J.G., and Beech, J.F., 2000, "Thickness of Liquid in Geosynthetic and Granular Liquid Collection Layers Comprising Two Sections With Different Slopes", *Geosynthetics International*, Special Issue on Liquid Collection Systems, Vol. 7, Nos. 4-6, pp. 453-489.
- Giroud, J.P. and Zhao, A., 2000, "Design of Liquid Collection Layer With Radial Flow", *Geosynthetics International*, Special Issue on Liquid Collection Systems, Vol. 7, Nos. 4-6, pp. 491-527.
- Giroud, J.P., and Soderman, K.L., 2000, "Criterion for Acceptable Bentonite Loss From a GCL Incorporated Into a Liner System", *Geosynthetics International*, Special Issue on Liquid Collection Systems, Vol. 7, Nos. 4-6, pp. 529-581.

- Giroud, J.P., Palmer, B., and Dove, J.E., 2000, "Calculation of Flow Velocity in Pipes as a Function of Flow Rate", *Geosynthetics International*, Special Issue on Liquid Collection Systems, Vol. 7, Nos. 4-6, pp. 583-600.
- Giroud, J.P., and Bonaparte, R., 2001, "Geosynthetics in Liquid-Containing Structures", Chapter 26, pp 789-824, in *Geotechnical and Geoenvironmental Engineering Handbook*, R.K. Rowe, Editor, Kluwer Academic Publishers, 1088 p.
- Thiel, R.S., Daniel, D.E., Erickson, R.B., Kavazanjian, E. and Giroud, J.P., 2001, "*The GSE GundSeal GCL Design Manual*", September 2001, 8 chapters plus appendices.
- Richardson, G.N., Giroud, J.P., and Zhao, A., 2002, "Lateral Drainage Update – Part 1", Designers Forum, *Geotechnical Fabrics Report*, IFAI, Roseville, Minesota, USA, January/February 2002, Vol. 20, No. 1, pp. 12-17.
- Richardson, G.N., Giroud, J.P., and Zhao, A., 2002, "Lateral Drainage Update – Part 1", Designers Forum, *Geotechnical Fabrics Report*, IFAI, Roseville, Minesota, USA, March 2002, Vol. 20, No. 2, pp. 18-21.
- Giroud, J.P., Thiel, R.S., Kavazanjian, E., and Lauro, F.J., 2002, "Hydrated area of a bentonite layer encapsulated between two geomembranes", *Proceedings of the 7<sup>th</sup> International Conference on Geosynthetics*, Nice, France, Balkema, Vol. 2, pp. 827-832.
- Giroud, J.P., 2003, "Filter Criteria", pp. 221-259, in *Jubilee Volume, 75th Anniversary of K. Terzaghi's "Erdbaumechanik" ("Soil Mechanics")*, H. Brandl, Editor, Reports of the Institute for Soil Mechanics and Geotechnical Engineering, Technical University of Vienna, Austria, 378 p.
- Giroud, J.P., and Touze-Foltz, N., 2003, "Geomembranes for Landfills", *Geosynthetics International*, Vol. 10, No. 4, pp. 124-133.
- Touze-Foltz, N., and Giroud, J.P., 2003, "Empirical equations for calculating the rate of liquid flow through composite liners due to geomembranes defects", *Geosynthetics International*, Vol. 10, No. 6, pp. 215-233.
- Giroud, J.P., Zhao, A., Tomlinson, H.M., and Zornberg, J.G., 2004, "Liquid flow equations for drainage systems composed of two layers including a geocomposite", *Geosynthetics International*, Vol. 11, No. 1, pp. 43-58.
- Giroud, J.P., and Daniel, D.E., 2004, "Liquid migration in an encapsulated bentonite layer due to geomembrane defects", *Geosynthetics International*, Special Issue on Geosynthetic Clay Liners, Vol. 11, No. 4, pp. 311-329.
- Giroud, J.P., Thiel, R.S., and Kavazanjian, E., 2004, "Hydrated area of a bentonite layer encapsulated between two geomembranes", *Geosynthetics International*, Special Issue on Geosynthetic Clay Liners, Vol. 11, No. 4, pp. 330-354.
- Giroud, J.P., "Criteria for Granular and Geotextile Filters", *IGS News*, Vol. 20, No. 3, November 2004, pp. 12-14.
- Giroud, J.P., 2005, "Geosynthetics engineering: successes, failures and lessons learned", The Vienna Terzaghi Lecture, pp. 11-54 in *Proceedings of 5. Osterreichische Geotechniktagung*, Osterreichischer Ingenieur und Architekten Verein, Vienna, February 2005, 583 p.

\* \* \* \* \*