After receipt of your corrections your article will be published initially within the online version of the journal.

**PLEASE AIM TO RETURN YOUR CORRECTIONS WITHIN 48 HOURS OF RECEIPT OF YOUR PROOF, THIS WILL ENSURE THAT THERE ARE NO UNNECESSARY DELAYS IN THE PUBLICATION OF YOUR ARTICLE**

- **READ PROOFS CAREFULLY**
  - This will be your only chance to correct your proof
  - Please note that the volume and page numbers shown on the proofs are for position only

- **ANSWER ALL QUERIES ON PROOFS** (Queries are attached as the last page of your proof.)
  - List all corrections and send back via e-mail to the production contact as detailed in the covering e-mail, or mark all corrections directly on the proofs and send the scanned copy via e-mail. Please do not send corrections by fax or post

- **CHECK FIGURES AND TABLES CAREFULLY**
  - Check size, numbering, and orientation of figures
  - All images in the PDF are downsampled (reduced to lower resolution and file size) to facilitate Internet delivery. These images will appear at higher resolution and sharpness in the printed article
  - Review figure legends to ensure that they are complete
  - Check all tables. Review layout, title, and footnotes

- **COMPLETE COPYRIGHT TRANSFER AGREEMENT (CTA) if you have not already signed one**
  - Please send a scanned signed copy with your proofs by e-mail. Your article cannot be published unless we have received the signed CTA

- **OFFPRINTS**
  - Free access to the final PDF offprint or your article will be available via Author Services only. Please therefore sign up for Author Services if you would like to access your article PDF offprint and enjoy the many other benefits the service offers.

**Additional reprint and journal issue purchases**

- Should you wish to purchase additional copies of your article, please click on the link and follow the instructions provided: [http://offprint.cosprinters.com/cos/bw/](http://offprint.cosprinters.com/cos/bw/)
- Corresponding authors are invited to inform their co-authors of the reprint options available.
- Please note that regardless of the form in which they are acquired, reprints should not be resold, nor further disseminated in electronic form, nor deployed in part or in whole in any marketing, promotional or educational contexts without authorization from Wiley. Permissions requests should be directed to mailto: permissionsuk@wiley.com
- For information about ‘Pay-Per-View and Article Select’ click on the following link: [http://olabout.wiley.com/WileyCDA/Section/id-404512.html](http://olabout.wiley.com/WileyCDA/Section/id-404512.html)
H₂S biofiltration using expanded schist as packing material: performance evaluation and packed-bed tortuosity assessment

E. Dumont,a* L. M. Ayala Guzman,b M. S. Rodríguez Susa b and Y. Andrèsa

Abstract

BACKGROUND: The aim of this work was to test an innovative packing material (expanded schist) for H₂S biofiltration in order to determine the packing material performance in terms of elimination capacity, removal efficiency and pressure drop changes. Additionally, the changes over time of bed characteristics, especially tortuosity, were evaluated according to porosity measurements.

RESULTS: Schist material can treat large loading rates (up to 30 g.m⁻³.h⁻¹) with 100% efficiency at an empty bed residence time (EBRT) of 16 s, which is much better than most results reported in the literature. The porosity of the packed bed is around 40% (tortuosity estimated to range from 1.5 to 2.0) which leads to pressure drop measurements in the range of 10 – 80 Pa m⁻¹.

CONCLUSION: Schist is a good material for H₂S biofiltration in terms of mechanical stability, removal efficiency and effective treatment of high H₂S loading rates. Schist is a material that provides the appropriate environment for micro-organisms by itself. This trend should be confirmed over a long period.

Keywords: biofiltration; packing material; H₂S; pressure drop; porosity; tortuosity

INTRODUCTION

Hydrogen sulphide (H₂S) is a toxic, colourless, flammable and unpleasant gas produced by several industries and activities. The odour threshold of the gas in humans ranges between 0.01 and 0.3 ppm.¹ Slight effects on human health occur at concentrations within the range 20–50 ppm of H₂S, while above 100 ppm irreversible after-effects occur such as acute conjunctivitis and pulmonary oedema. H₂S is also highly corrosive and causes damage to many materials. Nowadays, one of the major problems of H₂S is its presence in biogas, which causes corrosion in power engines.²

Due to the various sources of hydrogen sulphide emission and its high toxicity, it is crucial to investigate effective methods for its removal, especially when these sources are located near human settlements, as are sewage plants and industries. The removal techniques can be biological or non-biological, depending on the pollutant concentration and the loading rate. Biological techniques, such as biofiltration, are recommended for streams with low pollutant concentrations and high volumetric loading rates.³ Biofiltration offers advantages in terms of installation and operational costs. It is a technology that consumes little power, is simple to operate and has a long life. It has been demonstrated that biofiltration efficiency depends mainly on the packing material.³,⁴ The principal characteristics of an ideal packing material are high water content and good buffer capacity, as well as low density and high values for surface area and porosity. These factors promote biofilm formation, nutrient transport and the passage of the pollutant stream across the bed.⁵ Natural as well as synthetic packing materials have been used for H₂S biofiltration and their advantages and disadvantages are reported in the literature.³,⁶ One of the major problems in long-term biofilter operation is the increase in pressure drop because of excess biomass and bed compaction. Several authors have noted the relation between high pressure drop values and low removal efficiencies.⁷,⁸ Thus, the aim of this work was to test an innovative packing material (schist) for H₂S biofiltration with the following objectives: (i) determine the packing material performances in terms of elimination capacity, removal efficiency and pressure drop changes; and (ii) link these performances to the changes over time of bed characteristics, especially tortuosity. The latter was determined from porosity measurements by applying three models.⁹–¹¹

MATERIALS AND METHODS

Packing materials

Two packing materials were used: schist and UP20. The main packing material was produced in Mayenne (France) from naturally expanded schist. It was chosen due to its

* Correspondence to: E. Dumont, GEPEA, UMR CNRS 6144, Ecole des Mines de Nantes, 4 rue Alfred Kastler, BP 20722, 44307 Nantes Cedex 03-France. E-mail: eric.dumont@mines-nantes.fr; yves.andres@mines-nantes.fr

a GEPEA, UMR CNRS 6144, Ecole des Mines de Nantes, 4 rue Alfred Kastler, BP 20722, 44307 Nantes Cedex 03 - France

b Departamento de Ingeniería Civil y Ambiental, Facultad de Ingeniería, Universidad de los Andes, Bogotá – Colombia manuel.r@uniandes.edu.co
**Figure 1.** Packing materials, left: schist, right: UP20.

**Table 1.** Physical properties of the packing materials

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Schist</th>
<th>UP20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk density (kg m(^{-3}))</td>
<td>633</td>
<td>940</td>
</tr>
<tr>
<td>Density (kg m(^{-3}))</td>
<td>1120</td>
<td>1890</td>
</tr>
<tr>
<td>Water retention capacity (%)</td>
<td>6</td>
<td>48</td>
</tr>
<tr>
<td>Specific surface area (m(^2) m(^{-3}))</td>
<td>600</td>
<td>705</td>
</tr>
</tbody>
</table>

homogeneous shape and its size distribution. The schist pieces are roughly round with an average diameter of 10 mm (Fig. 1). The composition of the material is SiO\(_2\) (63%), Al\(_2\)O\(_3\) (21%), Fe\(_2\)O\(_3\) (8.5%), K\(_2\)O (3.6%), Na\(_2\)O (1.5%), MgO (1%), CaO (0.5%) and C (0.02%).

UP20 is a synthetic material manufactured in our laboratory whose formulation was presented in a previous paper\(^5\). The characteristics of this material are its buffering effect and its nutrient content, making the addition of extra buffer and nutrient solutions unnecessary. UP20 consists of CH\(_4\)NO\(_2\), H\(_3\)PO\(_4\), and CaCO\(_3\) (C/N/P molar ratio: 100/10/1) with an organic binder from the Elotex company (20% in mass). The Elotex binder is a white powder that contains ethylene and vinyl acetate. The biodegradability of UP20 was evaluated in a previous study\(^5\) for more than 1 year and no biodegradation was observed in this experiment. The UP20 material was fabricated as follows: (1) first, the dry salt powders and the binder were mixed in a container for 20 min, (2) then, water was added in an approximate proportion of 2/3 of the mixture and all the ingredients were blended, (3) next, the mix was extruded into a cylindrical shape with a meat mincer, (4) lastly, the pieces were dried at 50 °C for 20 h and cut into small pieces. The pieces measured 7 mm in diameter and around 10 mm in length (Fig. 1).

The physical properties of the packing materials are presented in Table 1.

**Experimental set-up**

The treatment of a synthetic gas polluted with H\(_2\)S was carried out in three laboratory-scale biofilters with the following configurations (Fig. 2):

(i) Biofilter 1: schist material inoculated with micro-organisms.
(ii) Biofilter 2: schist material without inoculation.
(iii) Biofilter 3: schist material + UP20 inoculated with micro-organisms.

All biofilters were 10 cm in diameter. Biofilters 1 and 2 were filled with 3.97 kg of schist (each 0.87 m in height, dark material in Fig. 2). Biofilter 3 was filled with 3.57 kg of schist (0.77 m in height) and 0.48 kg of UP20 (0.1 m in height, white material in Fig. 2). Biofilters 1 and 3 were inoculated with 3.76 g of sieved and washed activated sludge from the waste water treatment plant of Nantes, France.

For each biofilter, the polluted air was introduced into the bottom of the column. In order to ensure the optimal humidity of the bed, tap water was sprinkled on the top of the biofilters for periods of 5 min (corresponding to 318 mL) separated by...
10 min pauses. The gas flow to be treated was obtained by mixing H₂S (99.7% purity from a gas cylinder) with the airstream. The H₂S flow was controlled by a 5850S Brooks mass flow controller. Biofilters were operated continuously for at least 110 days (the stream temperature ranged from 12 to 25 °C). Various concentrations of H₂S (up to 200 mg m⁻³) measured with an Onyx 5220 device (accuracy ±1%) from the Cosma Environment SA Company, Passy, France) were used to determine the biofilter performances. The air flow range was 0.5–1.8 m³ h⁻¹, corresponding to superficial velocities between 89 and 229 m h⁻¹ (empty bed residence time (EBRT = V/Q) from 15 to 14 s). Five sampling ports, located along the columns at 20 cm intervals from the bottom, were used to measure pressure drop and H₂S concentration. Apart from the polluted air and UP20 for the same operating conditions, we recorded² that 100% efficiency was limited to loading rates up to 6 g m⁻³ h⁻¹. In the same way, using a synthetic inorganic BIOSORBENS biofilter medium (consisting of hydrophilic mineral cores coated with hydrophobic sorption material), Shareefdeen et al.² reported that, for H₂S concentrations up to 56 mg/m³, an EBRT = 30 s is required for complete removal (in such conditions, EC = LR = 6 g m⁻³ h⁻¹), whereas for lower concentrations (<16.8 mg m⁻³), an EBRT of only 20 s is needed. Barona et al.² testing four organic packing materials for H₂S removal (horse manure, sludge, soil and algae, pig manure and sawdust) demonstrated that only pig manure + sawdust material could reach high removal efficiency. For an EBRT = 24 s, they obtained elimination capacity values ranging from 5 g m⁻³ h⁻¹ (RE = 97%) to 46 g m⁻³ h⁻¹ (RE = 83%). It is interesting to note that these values are nonetheless lower than some spectacular results proposed in some studies³ – ⁷ (especially those using selected micro-organisms such as Thiobacillus thiooxidans). For example, removing H₂S from biogas in a lava rock biofilter,⁵ Ramirez-Saenz et al. reported an elimination capacity of 142 g m⁻³ h⁻¹ for an EBRT = 81 s and, surprisingly, an elimination capacity of 200 g m⁻³ h⁻¹ for an EBRT = 31 s (RE = 100%). Of the same order of magnitude, using Acidithioecillus thiooxidans to treat H₂S in a porous ceramic biofilter,⁶ Lee et al. described an elimination capacity of 160 g m⁻³ h⁻¹ for an EBRT = 6 s (RE = 96%). Lastly, using porous lava as a carrier of Thiobacillus thiooxidans in a laboratory-scale biofilter,⁷ Cho et al. reported a removal capacity of 428 g m⁻³ h⁻¹ for an EBRT = 12 s (RE = 100%). This result could be explained by the use of a specific sulphur-oxidizing bacteria (SOB) medium and the short running period (10 days). Eventually, it is interesting to underline results reported in the literature for other biological systems at very low EBRT. Using an alkaliphilic sulfoxidizing bacterial consortium in a laboratory-scale biotrickling filter for treating H₂S at pH = 10 (packing material: open-

![Figure 3](https://www.soci.org)
Comparing the biofilters in pairs, it is possible to deduce the following: (i) While removal efficiencies were limited to roughly 30–50%, schist material without initial inoculation was able to treat a part of the polluted air continuously (in Fig. 3, the lack of data in the first weeks is due to a malfunction in the H2S mass flowmeter; Biofilter 2 was not fed during this period). This surprising result is currently difficult to explain. Adsorption phenomena, as well as physical or chemical interactions between H2S and the schist material, can be assumed. Alternatively, the possible development of a biofilm (mainly due to the tap water used) cannot be excluded. Complementary studies should be carried out in order to understand these experimental observations. (ii) While no nutrients were added to Biofilter 1 (independently of the addition of activated sludge), no significant difference was observed between Biofilters 1 and 3 during the running period. This result confirms the specific behaviour of the schist material for biofiltration. Taking into account the high efficiencies recorded even at short EBRT, inoculated schist material could be satisfactory for large biofiltration applications (for instance, biogas purification).

**Pressure drop measurement and packed bed tortuosity calculation**

Pressure drops were measured daily between the ports located at 0.2 and 0.6 m in each biofilter. Values increased with the rise in superficial velocity varying between 89 and 229 m h\(^{-1}\) (Fig. 5). Pressure drop values varied in the range 10 to 80 Pa m\(^{-1}\), which indicates the good mechanical behaviour of the schist material. These values are much lower than those reported for other organic materials. Previous work with UP20 and pozzolan\(^4\) found maximum pressure drop of 150 Pa m\(^{-1}\), while the values for organic materials and UP20 ranged between 10 and 600 Pa m\(^{-1}\).

As can be observed in Fig. 5, pressure drop values were lower in Biofilter 2 (schist without inoculation) than in both inoculated biofilters. This fact can probably be attributed to biofilm growth in Biofilters 1 and 3, especially at the end of operation when the pollutant loads were higher and the biofilms were further developed. The changes over time in pressure drops can be related to the changes over time in the free-cross sectional area as well as a change in the bed porosity, which can lead to a change in the tortuosity (\(\tau\)) of the packed bed material. Tortuosity refers to the flow sinuosity along the biofilter and depends mainly on the porosity of the packed bed and the Reynolds number. It is affected by the configuration and density of the packed bed (which can be influenced by biofilm growth) and the presence of channels within the bed.\(^9\) The tortuosity is calculated from the ratio between the length of the channel and the total length of the packed bed and some models have been developed which depend on the porosity of the packed bed to determine this parameter.\(^9-11\) For beds randomly filled with identical particles,兰frey et al.\(^5\) proposed a simple relation between tortuosity, porosity (\(\epsilon\)) and particle sphericity (\(\psi\)):

\[
\tau = 1.23 \left( 1 - \epsilon \right)^{1/3} \left( \frac{1}{\psi^2} \right)
\]

The sphericity value \(\psi\) varies according to the particle shape, taking the value of 1 for round particles and less than 1 for other forms (\(V_p\) and \(S_p\) are the volume and the surface area of the particle, respectively). For particles having a cylindrical shape with
H₂S biofiltration using expanded schist as packing material

EBRT = 35 s
U = 89 m/h

EBRT = 25 s
U = 127 m/h

EBRT = 16 s
U = 191 m/h

EBRT = 14 s
U = 229 m/h

Figure 5. Pressure drops for the three biofilters at different EBRT.

a diameter equal to the length, the sphericity value is 0.87.

\[ \psi = \frac{(36 \pi V_p^2)^{1/3}}{d_p} \] (5)

In the case of a mixed bed of spherical particles significantly different in size,\(^\text{10}\) Dias et al. established an inverse relationship between tortuosity and porosity:

\[ \tau = \frac{1}{\varepsilon^n} \] (6)

The value of the parameter \(n\) lies in the range 0.4–0.5.\(^\text{10}\) The authors indicated that the variation may be explained by the distortion effect of the arrangement of small particles occurring near the surface of large particles and a jamming effect.

As tortuosity could change with biofilm development because it changes the flow pathway, it can be assumed that it could be related to the pressure drop measurement. Based on the Ergun equation, Comiti and Renaud developed a model to determine both the tortuosity and dynamic surface area of a packed bed\(^\text{11}\) (\(a_{vd}\) which can be different from the specific surface area if particles mutually overlap). From pressure drop measurements (Fig. 6), tortuosity can be obtained by solving Equations (7)–(9) with Microsoft Excel software. According to Mauret and Renaud, this model provides a good description of pressure drops for various media such as non-consolidated beds of spheres, parallelepipedal particles, short cylinders, fibrous media and metallic foams.\(^\text{21}\) It has also been satisfactorily applied to various biofilter carriers.\(^\text{22}\)

\[ \frac{\Delta P}{H U_0} = a U_0 + b \] (7)

where:

\[ a = \left[ 0.0413 \left( 1 - \left( 1 - \frac{d_p}{d_c} \right)^2 \right) + 0.0968 \left( 1 - \frac{d_p}{d_c} \right)^2 \right] \tau^3 \]

\[ \rho a_{vd} \left( 1 - \varepsilon \right) \]

\[ \frac{1}{\varepsilon^3} \]

\[ b = 2 \pi \tau^2 a_{vd} \left( 1 + \frac{4}{a_{vd} d_c (1 - \varepsilon)} \right) \left( 1 - \varepsilon \right)^2 \]

(8)

As observed in Equations (8) and (9), the model developed by Comiti and Renaud depends on various parameters (including the particle diameter \(d_p\), the column diameter \(d_c\) and the gas density \(\rho\)) but it is strongly dependent on porosity.\(^\text{11}\) For the three biofilters, packed bed porosity was measured in the following way (Fig. 7): before operating the biofilter, each column without packing material was filled with water to a fixed level (corresponding to a volume \(V_1\)). Once each column was filled with a known volume of material (\(V_2\)), the same procedure was carried out throughout the biofilter operation. A volume \(V_3\) was collected and it was then possible to calculate the packed bed porosity by using

\[ \varepsilon = \frac{V_2 - V_1 + V_3}{V_2} \] (10)

Figure 6. Example of pressure drop measurements for Biofilter 3. Validation of the linear change in pressure drop according to the model of Comiti and Renaud (Equation (7)). For these pressure drop measurements, the gas flow rate ranged from 0.5 to 4.0 Nm\(^3\) h\(^{-1}\) corresponding to an empty space velocity from 64 to 510 m.h\(^{-1}\). \(\odot\): day 0; \(\odot\): day 40; \(\odot\): day 58; \(\odot\): day 72; +: day 107.
CONCLUSION

Experimental investigations carried out on three laboratory-scale biofilters lead to the following conclusions:

Schist is a good material for H$_2$S biofiltration in terms of mechanical stability, removal efficiency and effective treatment of high H$_2$S loading rates at short EBRT (RE=100% for LR up to 30 g m$^{-3}$ h$^{-1}$ at EBRT = 16 s).
For the running period used (110 days), UP20 material does not make a significant difference to H2S biofiltration. This result demonstrates that schist is a material that provides the appropriate environment for micro-organisms by itself. This trend should be confirmed over a long period.

The porosity of the packed bed is around 40% which leads to pressure drop measurements in the range 10–80 Pa m⁻¹. From porosity values and according to the equation of Lanfrey et al. (2010), the tortuosity of the packed bed is estimated to range from 1.5 to 2.0. Due to its great sensitivity to porosity value and pressure drop measurement, the model of Comiti and Renaud (1989) is not appropriate to provide accurate changes in tortuosity and superficial area for the packed bed.

**REFERENCES**

WILEY AUTHOR DISCOUNT CLUB

We would like to show our appreciation to you, a highly valued contributor to Wiley’s publications, by offering a **unique 25% discount** off the published price of any of our books*.

All you need to do is apply for the **Wiley Author Discount Card** by completing the attached form and returning it to us at the following address:

The Database Group (Author Club)  
John Wiley & Sons Ltd  
The Atrium  
Southern Gate  
Chichester  
PO19 8SQ  
UK

Alternatively, you can register online at [www.wileyeurope.com/go/authordiscount](http://www.wileyeurope.com/go/authordiscount)

Please pass on details of this offer to any co-authors or fellow contributors.

After registering you will receive your Wiley Author Discount Card with a special promotion code, which you will need to quote whenever you order books direct from us.

The quickest way to order your books from us is via our European website at:

**http://www.wileyeurope.com**

Key benefits to using the site and ordering online include:  
Real-time SECURE on-line ordering  
Easy catalogue browsing  
Dedicated Author resource centre  
Opportunity to sign up for subject-orientated e-mail alerts

Alternatively, you can order direct through Customer Services at:  
cs-books@wiley.co.uk, or call +44 (0)1243 843294, fax +44 (0)1243 843303

So take advantage of this great offer and return your completed form today.

Yours sincerely,

Verity Leaver  
Group Marketing Manager  
[author@wiley.co.uk](mailto:author@wiley.co.uk)

---

**TERMS AND CONDITIONS**

This offer is exclusive to Wiley Authors, Editors, Contributors and Editorial Board Members in acquiring books for their personal use. There must be no resale through any channel. The offer is subject to stock availability and cannot be applied retrospectively. This entitlement cannot be used in conjunction with any other special offer. Wiley reserves the right to amend the terms of the offer at any time.
To enjoy your 25% discount, tell us your areas of interest and you will receive relevant catalogues or leaflets from which to select your books. Please indicate your specific subject areas below.

<table>
<thead>
<tr>
<th>Accounting</th>
<th>[ ]</th>
<th>Architecture [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>[ ]</td>
<td>Business/Management [ ]</td>
</tr>
<tr>
<td>Corporate</td>
<td>[ ]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemistry</th>
<th>[ ]</th>
<th>Computer Science [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical</td>
<td>[ ]</td>
<td>Database/Data Warehouse [ ]</td>
</tr>
<tr>
<td>Industrial/Safety</td>
<td>[ ]</td>
<td>Internet Business [ ]</td>
</tr>
<tr>
<td>Organic</td>
<td>[ ]</td>
<td>Networking [ ]</td>
</tr>
<tr>
<td>Inorganic</td>
<td>[ ]</td>
<td>Programming/Software [ ]</td>
</tr>
<tr>
<td>Polymer</td>
<td>[ ]</td>
<td>Development [ ]</td>
</tr>
<tr>
<td>Spectroscopy</td>
<td>[ ]</td>
<td>Object Technology [ ]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Encyclopedia/Reference</th>
<th>[ ]</th>
<th>Engineering [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business/Finance</td>
<td>[ ]</td>
<td>Civil [ ]</td>
</tr>
<tr>
<td>Life Sciences</td>
<td>[ ]</td>
<td>Communications Technology [ ]</td>
</tr>
<tr>
<td>Medical Sciences</td>
<td>[ ]</td>
<td>Electronic [ ]</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>[ ]</td>
<td>Environmental [ ]</td>
</tr>
<tr>
<td>Technology</td>
<td>[ ]</td>
<td>Industrial [ ]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mechanical [ ]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Earth &amp; Environmental Science</th>
<th>[ ]</th>
<th>Finance/Investing [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Economics [ ]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Institutional [ ]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Personal Finance [ ]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Genetics</th>
<th>[ ]</th>
<th>Life Science [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioinformatics/Computational Biology</td>
<td>[ ]</td>
<td>Landscape Architecture [ ]</td>
</tr>
<tr>
<td>Proteomics</td>
<td>[ ]</td>
<td>Mathematics [ ]</td>
</tr>
<tr>
<td>Genomics</td>
<td>[ ]</td>
<td>Statistics [ ]</td>
</tr>
<tr>
<td>Gene Mapping</td>
<td>[ ]</td>
<td>Manufacturing [ ]</td>
</tr>
<tr>
<td>Clinical Genetics</td>
<td>[ ]</td>
<td>Materials Science [ ]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medical Science</th>
<th>[ ]</th>
<th>Psychology [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>[ ]</td>
<td>Clinical [ ]</td>
</tr>
<tr>
<td>Diabetes</td>
<td>[ ]</td>
<td>Forensic [ ]</td>
</tr>
<tr>
<td>Endocrinology</td>
<td>[ ]</td>
<td>Social &amp; Personality [ ]</td>
</tr>
<tr>
<td>Imaging</td>
<td>[ ]</td>
<td>Health &amp; Sport [ ]</td>
</tr>
<tr>
<td>Obstetrics/Gynaecology</td>
<td>[ ]</td>
<td>Cognitive [ ]</td>
</tr>
<tr>
<td>Oncology</td>
<td>[ ]</td>
<td>Organizational [ ]</td>
</tr>
<tr>
<td>Pharmacology</td>
<td>[ ]</td>
<td>Developmental &amp; Special Ed [ ]</td>
</tr>
<tr>
<td>Psychiatry</td>
<td>[ ]</td>
<td>Child Welfare [ ]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Self-Help [ ]</td>
</tr>
</tbody>
</table>

| Non-Profit                  | [ ] | Physics/Physical Science [ ] |

Please complete the next page /
I confirm that I am (*delete where not applicable):

a Wiley Book Author/Editor/Contributor* of the following book(s):

ISBN:
ISBN:

a Wiley Journal Editor/Contributor/Editorial Board Member* of the following journal(s):

SIGNATURE: ……………………………………………………………………………………         Date: ………………………………………

PLEASE COMPLETE THE FOLLOWING DETAILS IN BLOCK CAPITALS:

TITLE: (e.g. Mr, Mrs, Dr) ...............  FULL NAME: ........................................................................................................

JOB TITLE (or Occupation): .......................................................... ..........................................................

DEPARTMENT: ..................................................................................................................

COMPANY/INSTITUTION: ........................................................................................................

ADDRESS: ..........................................................................................................................

..........................................................................................................................

TOWN/CITY: ..................................................................................................................

COUNTY/STATE: ............................................................................................................

COUNTRY: ......................................................................................................................

POSTCODE/ZIP CODE: ................................................................................................

DAYTIME TEL: ................................................................................................................

FAX: ..............................................................................................................................

E-MAIL: ........................................................................................................................

YOUR PERSONAL DATA
We, John Wiley & Sons Ltd, will use the information you have provided to fulfil your request. In addition, we would like to:

1. Use your information to keep you informed by post of titles and offers of interest to you and available from us or other Wiley Group companies worldwide, and may supply your details to members of the Wiley Group for this purpose.
   [ ] Please tick the box if you do NOT wish to receive this information

2. Share your information with other carefully selected companies so that they may contact you by post with details of titles and offers that may be of interest to you.
   [ ] Please tick the box if you do NOT wish to receive this information.

E-MAIL ALERTING SERVICE
We also offer an alerting service to our author base via e-mail, with regular special offers and competitions. If you DO wish to receive these, please opt in by ticking the box [ ].

If, at any time, you wish to stop receiving information, please contact the Database Group (databasegroup@wiley.co.uk) at John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, PO19 8SQ, UK.

TERMS & CONDITIONS
This offer is exclusive to Wiley Authors, Editors, Contributors and Editorial Board Members in acquiring books for their personal use. There should be no resale through any channel. The offer is subject to stock availability and may not be applied retrospectively. This entitlement cannot be used in conjunction with any other special offer. Wiley reserves the right to vary the terms of the offer at any time.

PLEASE RETURN THIS FORM TO:
Database Group (Author Club), John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, PO19 8SQ, UK author@wiley.co.uk
Fax: +44 (0)1243 770154