Kidneystones analysis by FTIR

At the Bosch Medicentrum, a hospital in the center of ’s-Hertogenbosch, the Netherlands, an FTIR spectral library has been developed consisting of lots of kidneystones with a known composition. Since most of the stones are also analysed by XRF the concentration of the components is known too.

The FTIR library is a helpful tool to analyse the patients kidneystones. At all the infrared spectroscopy is a very well known technique doing this style of analysis [1-3]. A more new aspect using it, is the reduction of sample preparation and analysis time due to high speed FTIR technology and accessory selection.

The sample preparation itself is reduced to the following activities. At first, the stone is grinded in a mortar to obtain a fine powder. This is necessary because the differences in particle size may effect the IR spectrum. Then, a very small part of this powder (only a few milligrams) is put on the diamond-crystal of the Golden Gate and the following spectrum is measured (Figure 2).

When this spectrum is searched in the library the result will be as shown in figure 3.

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When this spectrum is searched in the library the result will be as shown in figure 3.

The result is, that the determined stone material consists of 11 % Whewellite, 47 % Apatite, and 42 % Struvite. In this way the chemical content and the concentration of the components can be determined quickly and easy.

<table>
<thead>
<tr>
<th>Stone</th>
<th>1</th>
<th>2</th>
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<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
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<tbody>
<tr>
<td>% Whewellite</td>
<td>11%</td>
<td>62%</td>
<td>56%</td>
<td>43%</td>
<td>49%</td>
<td>54%</td>
<td>78%</td>
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<tr>
<td>% Apatite</td>
<td>47%</td>
<td>13%</td>
<td>39%</td>
<td>57%</td>
<td>32%</td>
<td>37%</td>
<td>22%</td>
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<td>5%</td>
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<tr>
<td>% Struvite</td>
<td>42%</td>
<td>25%</td>
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<td>5%</td>
<td>0%</td>
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Comparison measurements have been done on the new FTIR-8400S (Figure 1) and the IRSolution software.

Figure 1: FTIR-8400S: Single-beam instrument with completely encapsulated optics.

Figure 2: Spectrum of a kidneystone with unknown composition.

Figure 3: Typical Search result using a homemade library.

Figure 4: FTIR kidneystones library created with the FTIR-8400 and Golden Gate (KRS-5 lenses).

Table: FTIR kidneystones library.

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Figure 1: FTIR-8400S: Single-beam instrument with completely encapsulated optics investigated. Nowadays, it is possible to use the more comfortable and easy to handle ATR technique, and the sample preparation is reduced to nearly zero. The instrument used at the Bosch Medicentrum is an FTIR-8400 with Hyper IR software Version 1.57 and a Golden Gate with KRS-5 lenses. With those optics the range is extended down to 355 cm⁻¹.

Figure 2: Spectrum of a kidneystone with unknown composition

Figure 3: Typical Search result using a homemade library

Figure 4: FTIR kidneystones library created with the FTIR-8400 and Golden Gate (KRS-5 lenses)

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