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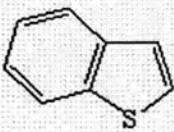
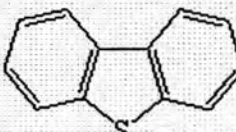
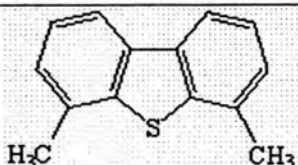
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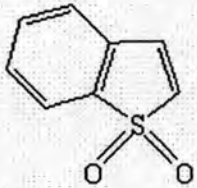
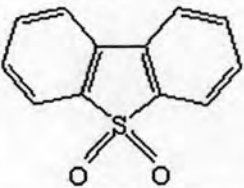
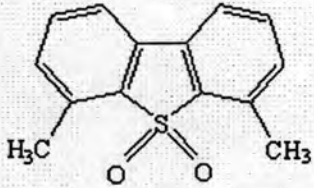
**APPENDICES**

## APPENDIX A

**Table 4.14** Properties of the model sulfur compounds

| property           | benzothiophene  | dibenzothiophene   | 4,6-dimethyl dibenzothiophene   |
|--------------------|---|--|---|
| Chemical formula   | $C_8H_6S$   | $C_{12}H_8S$   | $C_{14}H_{12}S$   |
| Molecular weight   | 134.3   | 184.3  | 212.3   |
| Physical           | liquid  | white crystal  | yellow crystal  |
| Chemical structure |  |  |  |

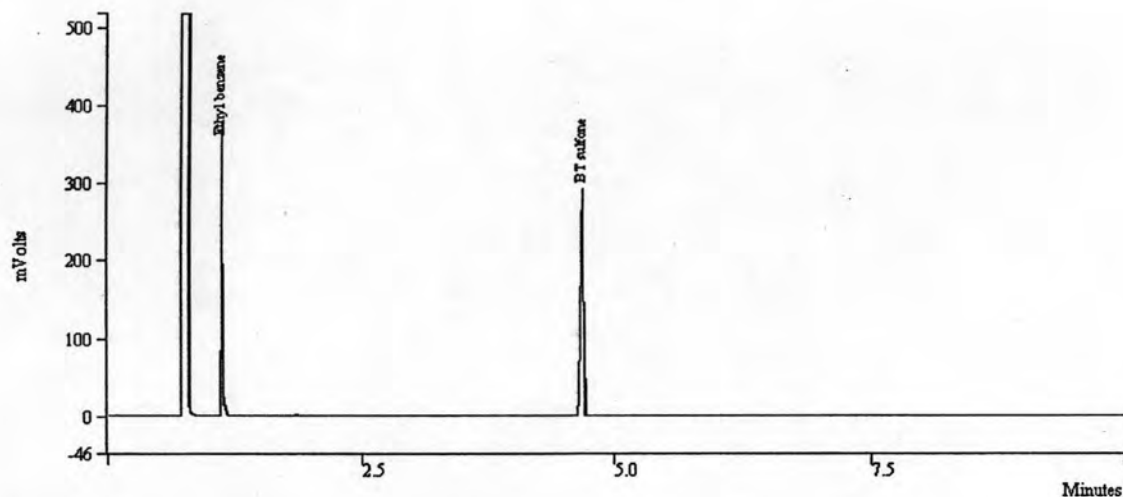
**Table 4.15** Properties of oxidized product

| property           | Benzothiophene sulfone  | Dibenzothiophene sulfone   | 4,6-dimethyl dibenzothiophene sulfone   |
|--------------------|---|--|---|
| Chemical formula   | $C_8H_6SO_2$  | $C_{12}H_8SO_2$  | $C_{14}H_{12}SO_2$  |
| Molecular weight   | 166.3   | 216.3  | 244.3   |
| Physical           | white crystal   | white crystal  | yellow crystal  |
| Chemical structure |  |  |  |



## B. Correction factor

### Correction factor of benzothiophene (BT sulfone):



| Peak No       | Peak Name     | Result ()       | Ret Time (min) | Time Offset (min) | Peak Area (counts) | Rel Ret Time | Sep. Code | Width 1/2 (sec) |
|---------------|---------------|-----------------|----------------|-------------------|--------------------|--------------|-----------|-----------------|
| 1             | Ethyl benzene | 32.2213         | 1.093          | 0.000             | 267665             | 0.00         | BB        | 0.6             |
| 2             | BT sulfone    | 67.7787         | 4.687          | 0.000             | 563043             | 0.00         | BB        | 1.8             |
| <b>Totals</b> |               | <b>100.0000</b> |                | <b>0.000</b>      | <b>830708</b>      |              |           |                 |

**Figure 4.13** A gas chromatogram of BT sulfone for correction factor calculation.

The correction factor was calculated based upon the results obtained from gas chromatographic analysis. Ethyl benzene was used as internal standard.

exact amount of BT sulfone prepared =  $0.2 \times 10^{-3}$  mol

exact amount of internal standard added =  $2.449 \times 10^{-5}$  mmol

peak area of BT sulfone prepared = 563043

peak area of the internal standard = 267665

total volume of the reaction = 10 mL

The calculation of the correction factor can be described as follows:

mol of BT sulfone

$$= \frac{\text{exact amount of internal standard} \times \text{peak area of BT sulfone} \times \text{total volume}}{\text{Peak area of internal standard}}$$

$$= \frac{(2.449 \times 10^{-5} \times 563043 \times 10)}{267665}$$

$$= 5.15 \times 10^{-4}$$

Thus, the correction factor of BT sulfone can be calculated as:

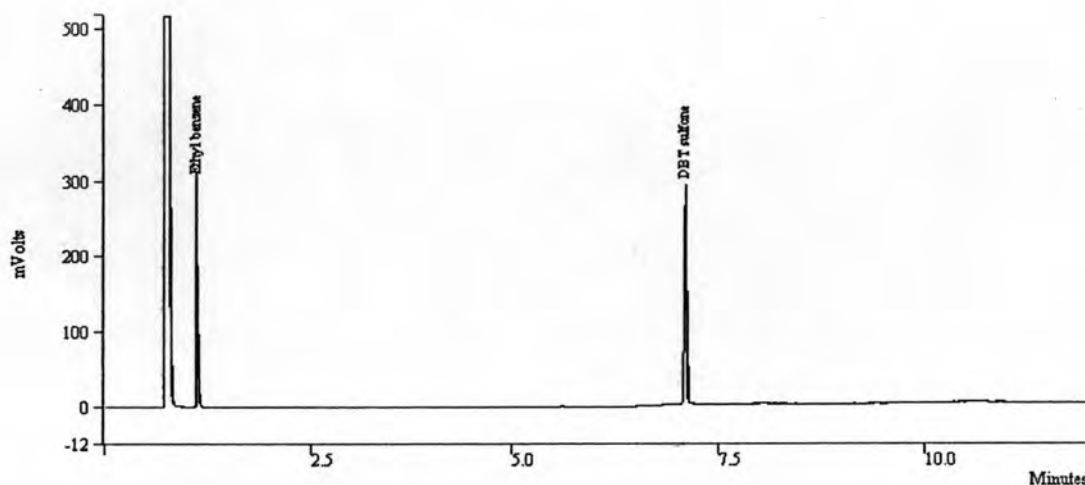
$$= \frac{\text{Exact amount of BT sulfone}}{\text{mol of BT sulfone}}$$

$$= \frac{0.2 \times 10^{-3}}{5.15 \times 10^{-4}}$$

$$= 0.38$$

The correction factor of BT sulfone = 0.38

### Correction factor of dibenzothiophene (DBT sulfone):



| Peak No       | Peak Name     | Result ()       | Ret Time (min) | Time Offset (min) | Peak Area (counts) | Rel Ret Time | Sep. Code | Width 1/2 (sec) |
|---------------|---------------|-----------------|----------------|-------------------|--------------------|--------------|-----------|-----------------|
| 1             | Ethyl benzene | 34.4664         | 1.092          | 0.000             | 72793              | 0.00         | BB        | 0.7             |
| 2             | DBT sulfone   | 65.5336         | 7.103          | 0.000             | 138406             | 0.00         | BB        | 1.6             |
| <b>Totals</b> |               | <b>100.0000</b> |                | <b>0.000</b>      | <b>211199</b>      |              |           |                 |

Figure 4.14 A gas chromatogram of DBT sulfone for correction factor calculation.

The correction factor was calculated based upon the results obtained from gas chromatographic analysis. Ethyl benzene was used as internal standard.

exact amount of BT sulfone prepared =  $0.2 \times 10^{-3}$  mol

exact amount of internal standard added =  $2.449 \times 10^{-5}$  mmol

peak area of BT sulfone prepared = 138406

peak area of the internal standard = 72793

total volume of the reaction = 10 mL

The calculation of the correction factor can be described as follows:

mol of DBT sulfone

$$= \frac{\text{exact amount of internal standard} \times \text{peak area of DBT sulfone} \times \text{total volume}}{\text{Peak area of internal standard}}$$

$$= \frac{(2.449 \times 10^{-5} \times 138406 \times 10)}{72793}$$

$$= 4.656 \times 10^{-4}$$

Thus, the correction factor of DBT sulfone can be calculated as:

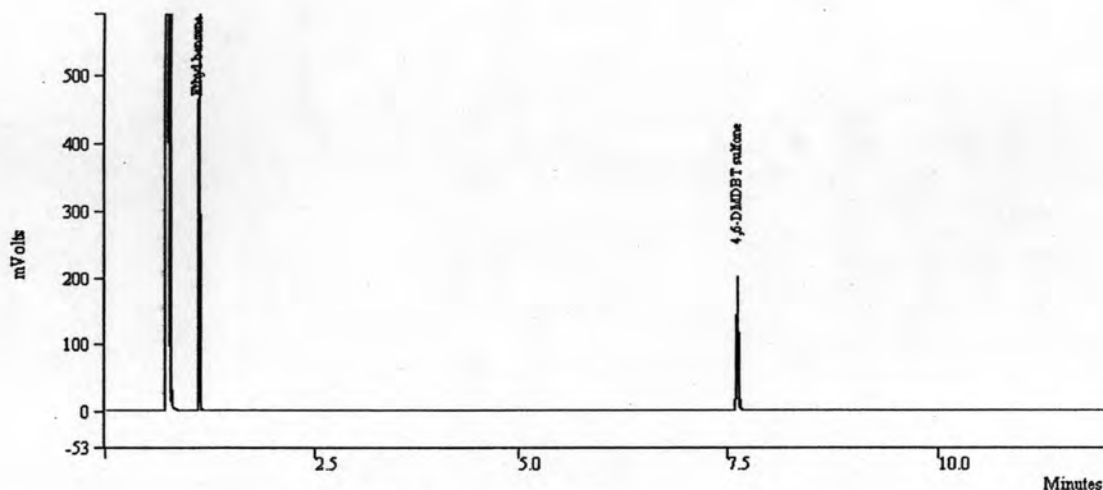
$$= \frac{\text{Exact amount of DBT sulfone}}{\text{mol of DBT sulfone}}$$

$$= \frac{0.2 \times 10^{-3}}{4.656 \times 10^{-4}}$$

$$= 0.42$$

The correction factor of DBT sulfone = 0.42

### Correction factor of 4,6-Dimethyldibenzothiophene (4,6-DMDBT sulfone):



| Peak No       | Peak Name         | Result ()       | Ret Time (min) | Time Offset (min) | Peak Area (counts) | Rel Ret Time | Sep. Code | Width 1/2 (sec) |
|---------------|-------------------|-----------------|----------------|-------------------|--------------------|--------------|-----------|-----------------|
| 1             | Ethyl benzene     | 33.6280         | 1.092          | 0.000             | 273930             | 0.00         | BB        | 0.6             |
| 2             | 4,6-DMDBT sulfone | 66.3720         | 7.624          | 0.000             | 540660             | 0.00         | BB        | 2.0             |
| <b>Totals</b> |                   | <b>100.0000</b> |                | <b>0.000</b>      | <b>814590</b>      |              |           |                 |

**Figure 4.15** A gas chromatogram of 4,6-DMDBT sulfone for correction factor calculation.

The correction factor was calculated based upon the results obtained from gas chromatographic analysis. Ethyl benzene was used as internal standard.

exact amount of 4,6-DMDBT sulfone prepared =  $0.2 \times 10^{-3}$  mol

exact amount of internal standard added =  $2.449 \times 10^{-5}$  mmol

peak area of 4,6-DMDBT sulfone prepared = 540660

peak area of the internal standard = 273930

total volume of the reaction = 10 mL



The calculation of the correction factor can be described as follows:

mol of 4,6-DMDBT sulfone

$$= \frac{\text{exact amount of internal standard} \times \text{peak area of 4,6-DMDBT sulfone} \times \text{total volume}}{\text{Peak area of internal standard}}$$

$$= \frac{(2.449 \times 10^{-5} \times 540660 \times 10)}{273930}$$

$$= 4.83 \times 10^{-4}$$

Thus, the correction factor of 4,6-DMDBT sulfone can be calculated as:

$$= \frac{\text{Exact amount of 4,6-DMDBT sulfone}}{\text{mol of DBT sulfone}}$$

$$= \frac{0.2 \times 10^{-3}}{4.83 \times 10^{-4}}$$

$$= 0.41$$

The correction factor of 4,6-DMDBT sulfone = 0.41

## VITAE

Ms. Kanjanaporn Rujiraworawut was born on January 21<sup>st</sup>, 1984 in Chon buri, Thailand. She received a Bachelor Degree of Science, major a Chemistry from Prince of Songkla University in 2005. Since 2005 she has been graduated student in the Program of Petrochemistry and Polymer Science, Faculty of Science, Chulalongkorn University and graduated in 2007.

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