

Contents

Preface vii

1. Enhanced Oil Recovery: A Potential Role for Microorganisms 1

- 1.1. Value of enhanced recovery 2
- 1.2. Conventional procedures for oil recovery 4
- 1.3. Brief survey of non-biological enhanced recovery 11
- 1.4. Conclusions 16
- References 18

2. About Microbiology — And Its Relevance for Enhanced Oil Recovery 19

- 2.1. General considerations 19
- 2.2. Types of microorganisms 21
- 2.3. How might bacteria contribute to enhanced oil recovery? 25
- 2.4. Bacterial metabolism 27
- 2.5. Regulation of bacterial metabolism 29
- 2.6. Role of inheritance and environment 32
- 2.7. Phenotypic and genotypic stability 34
- 2.8. Environmental limits to growth 35
- 2.9. Genetic manipulation: isolation of desired bacterial forms 37
- 2.10. Conclusions 42
- General supplementary reading 42

3. Reservoir Microbiology	44
3.1. Presence and growth of bacteria in reservoirs	44
3.2. Undesirable behaviour of bacteria in reservoirs	48
3.3. Measures to control bacterial growth in relation to enhanced oil recovery techniques	57
3.4. Penetration of bacteria through rock formations	60
References	66
4. Experience of Bacterial Enhanced Recovery Techniques	69
4.1. A brief history	69
4.2. The original ideas	70
4.3. The first development of ZoBell's work	71
4.4. Later work in the United States	72
4.5. Field trials and other work in Europe	76
4.6. Availability of wells for microbiological field trials	85
4.7. Choice of suitable wells	88
4.8. Isolation of suitable bacteria	90
4.9. Evaluating the benefits of enhanced recovery procedures	93
4.10. Limitations of the method and the risks of failure	94
4.11. Opportunities for success with bacterial enhancement methods	99
References	101
The Exploitation of Deep and Offshore Fields	106
5.1. Special problems of deep and offshore fields	106
5.2. How to obtain a suitable bacterial culture for enhanced oil recovery	119
References	139
6. Getting Started: Matters of Logistics	143
6.1. Are general solutions feasible?	144
6.2. Identification of target wells and reservoirs	45
6.3. Who is going to develop bacterial enhancement methods?	146
6.4. How urgent is it to start?	148
6.5. The molasses-based technique	149

6.6. Methods using specifically designed bacteria	150
6.7. Obtaining wells for field trials	151
6.8. Compatibility between bacterial and other recovery methods	152
6.9. Resources required for bacterial injection	153
6.10. The longer term view	155
References	156
7. New Initiatives and Current Activities	157
7.1. United States	157
7.2. United Kingdom	161
7.3. Conclusion	162
References	163
<i>Glossary of Biological Terms</i>	164
<i>Index</i>	173