

In-Situ Air Sparging

API PUBLICATION 1628D
FIRST EDITION, JULY 1996





One of the most significant long-term trends affecting the future vitality of the petroleum industry is the public's concerns about the environment. Recognizing this trend, API member companies have developed a positive, forward looking strategy called STEP: Strategies for Today's Environmental Partnership. This program aims to address public concerns by improving industry's environmental, health and safety performance; documenting performance improvements; and communicating them to the public. The foundation of STEP is the API Environmental Mission and Guiding Environmental Principles. API standards, by promoting the use of sound engineering and operational practices, are an important means of implementing API's STEP program.

API ENVIRONMENTAL MISSION AND GUIDING ENVIRONMENTAL PRINCIPLES

The members of the American Petroleum Institute are dedicated to continuous efforts to improve the compatibility of our operations with the environment while economically developing energy resources and supplying high quality products and services to consumers. The members recognize the importance of efficiently meeting society's needs and our responsibility to work with the public, the government, and others to develop and to use natural resources in an environmentally sound manner while protecting the health and safety of our employees and the public. To meet these responsibilities, API members pledge to manage our businesses according to these principles:

- To recognize and to respond to community concerns about our raw materials, products and operations.
- To operate our plants and facilities, and to handle our raw materials and products in a manner that protects the environment, and the safety and health of our employees and the public.
- To make safety, health and environmental considerations a priority in our planning, and our development of new products and processes.
- To advise promptly appropriate officials, employees, customers and the public of information on significant industry-related safety, health and environmental hazards, and to recommend protective measures.
- To counsel customers, transporters and others in the safe use, transportation and disposal of our raw materials, products and waste materials.
- To economically develop and produce natural resources and to conserve those resources by using energy efficiently.
- To extend knowledge by conducting or supporting research on the safety, health and environmental effects of our raw materials, products, processes and waste materials.
- To commit to reduce overall emissions and waste generation.
- To work with others to resolve problems created by handling and disposal of hazardous substances from our operations.
- To participate with government and others in creating responsible laws, regulations and standards to safeguard the community, workplace and environment.
- To promote these principles and practices by sharing experiences and offering assistance to others who produce, handle, use, transport or dispose of similar raw materials, petroleum products and wastes.



In-Situ Air Sparging

Manufacturing, Distribution and Marketing Department

API PUBLICATION 1628D
FIRST EDITION, JULY 1996



SPECIAL NOTES

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations under local, state, or federal laws.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the material safety data sheet.

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. Sometimes a one-time extension of up to two years will be added to this review cycle. This publication will no longer be in effect five years after its publication date as an operative API standard or, where an extension has been granted, upon republication. Status of the publication can be ascertained from the API Authoring Department [telephone (202) 682-8000]. A catalog of API publications and materials is published annually and updated quarterly by API, 1220 L Street, N.W., Washington, D.C. 20005.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this standard or comments and questions concerning the procedures under which this standard was developed should be directed in writing to the director of the Authoring Department (shown on the title page of this document), American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any federal, state, or municipal regulation with which this publication may conflict.

API standards are published to facilitate the broad availability of proven, sound engineering and operating practices. These standards are not intended to obviate the need for applying sound engineering judgment regarding when and where these standards should be utilized. The formulation and publication of API standards is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

All rights reserved. No part of this work may be reproduced, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 1220 L Street, N.W., Washington, D.C. 20005.

FOREWORD

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any federal, state, or municipal regulation with which this publication may conflict.

Suggested revisions are invited and should be submitted to the director of the Manufacturing, Distribution and Marketing Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

CONTENTS

	Page
SECTION 1—INTRODUCTION	1
1.1 Scope	1
1.1 Techniques	1
SECTION 2—GOVERNING PHENOMENA	1
2.1 In-Situ Air Stripping	1
2.2 Direct Volatilization	3
2.3 Biodegradation	3
SECTION 3—APPLICABILITY	3
3.1 Examples of Compound Applicability	3
3.2 Geological Considerations	5
SECTION 4—DESCRIPTION OF THE PROCESS	5
4.1 Air Injection Into Water-Saturated Soils	5
4.2 Mounding of Water Table	6
4.3 Distribution of Air Flow Pathways	6
SECTION 5—SYSTEM DESIGN PARAMETERS	6
5.1 Air Distribution	6
5.2 Depth of Air Injection	8
5.3 Air Injection Pressure and Flow Rate	8
5.4 Injection Wells	8
5.5 Chemical(s) of Concern and Distribution	8
SECTION 6—PILOT TESTING	10
6.1 Preliminary Evaluation	10
6.2 Data Collection	10
6.2.1 Zone of Air Distribution	10
6.2.2 Injection Air Pressure	10
6.2.3 Injection Flow Rate	10
6.2.4 Mass Removal Efficiency	10
SECTION 7—LIMITATIONS	11
SECTION 8—REMEDICATION RATES	11
SECTION 9—DATA GAPS	11
SECTION 10—SUMMARY OF CASE STUDIES IN THE LITERATURE	12
10.1 Chemical(s) of Concern Treated	12
10.2 Soil Types	12
10.3 Sparging Depth	12
10.4 Remediation Times	12
SECTION 11—REFERENCES	12

Figures

1—Air Sparging Process Schematic	2
2—Qualitative Presentation of Potential Air Sparging Mass Removal for Petroleum Compounds	4
3—Air Sparging Test Measurements	7
4—Schematic Showing the Conventional Design of an Air Sparging Point for Shallower Applications	9
5—Diagram of a Nested Sparge Well for Deeper Applications	9

Tables

1—Examples of Compound Applicability for In-Situ Air Sparging	3
2—Considerations for Evaluation Prior to Designing a Pilot Test	10