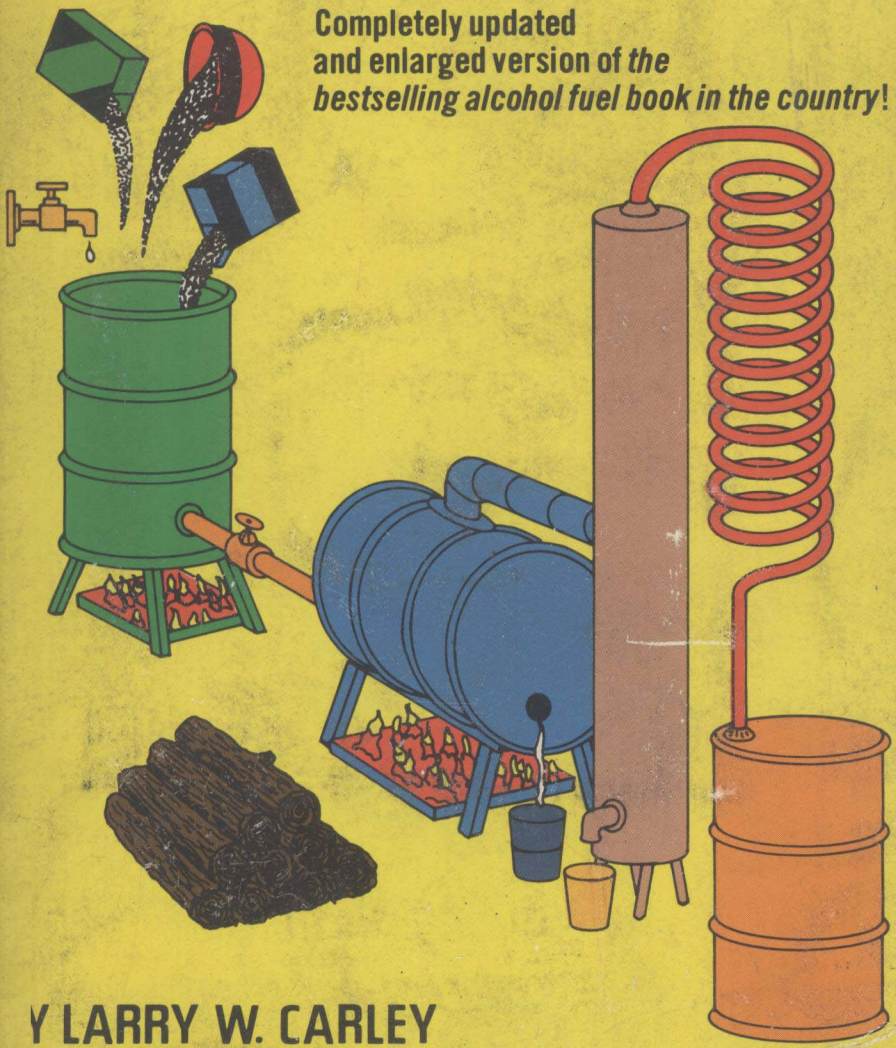
TAB 2084

$7.95

HOW TO MAKE YOUR OWN ALCOHOL FUELS

2ND EDITION

Completely updated and enlarged version of *the bestselling alcohol fuel book in the country*!



BY LARRY W. CARLEY

HOW TO MAKE YOUR OWN ALCOHOL FUELS —2ND EDITION

BY LARRY W. CARLEY

TAB TAB BOOKS Inc.
BLUE RIDGE SUMMIT, PA. 17214

SECOND EDITION

SECOND PRINTING

Printed in the United States of America

Library of Congress Cataloging in Publication Data

Carley, Larry W.
How to make your own alcohol fuels.

Includes index.
1. Alcohol as fuel. I. Title.
TP358.C38 1981 662'.669 81-9109
ISBN 0-8306-0047-7 AACR2
ISBN 0-8306-2084-2 (pbk.)

Contents

Foreword

The purpose of this book is to provide the reader with the basic background information necessary for the home production and use of alcohol fuel. Using this information, the do-it-yourselfer can design and build a still and make the appropriate modifications to the equipment so that it will run on alcohol fuel. For this reason, the author and publisher assume no responsibility or liability for the use or misuse of such home-made distilling equipment, alcohol fuel or modifications to vehicles or equipment.

It should also be noted that this is not a moonshiner's manual. The procedures and equipment described in this book are for the home production of fuel alcohol only—not drinking alcohol. Fuel grade alcohol might contain various contaminants that can be harmful or fatal if taken internally. It is against the law to manufacture drinking alcohol without a special permit from the Bureau of Alcohol, Tobacco & Firearms. Failure to obey the law can result in severe criminal penalties.

Larry W. Carley

Introduction

This is a book about alcohol fuel. It's also a book about self-sufficiency, economic opportunity and good 'ol American ingenuity.

Each passing day brings with it a greater concern over the future cost and availability of gasoline and diesel fuel. Nobody can predict the eventual outcome of our present energy crisis or how much we will be paying for fuel next year or the year after—or even if we'll have fuel available at any price. This is why we need to pursue energy alternatives now.

After talking with numerous individuals who are involved directly and indirectly with the alcohol fuel movement, alcohol production, still manufacturing, engine conversions, energy research, fuels research and agricultural equipment manufacturing, I'm convinced alcohol is the best alternative we have.

Alcohol is the one fuel that comes closest to being the ideal replacement for gasoline.

Not everybody agrees that alcohol is the way to go. A wealth of opinion about the value of alcohol as a fuel is sharply divided. Some people are stubbornly against it without good reason, for selfish reasons, because they're misinformed or because they believe the anti-alcohol propaganda circulated by certain special interest groups. Other people are staunchly in favor of using alcohol fuel for no good reason, for selfish reasons, because they believe the pro-alcohol propaganda—or because they've examined the facts and reached an intelligent conclusion.

The controversy over alcohol fuels stems from our economic dependence on a single fuel resource—petroleum. And any threat to the established order is bound to meet with stiff resistance.

Considering alcohol as a viable alternative to petroleum means changing the way we think about energy production. It means changing from a non-renewable fossil fuel to a resource we can grow for ourselves. It means eliminating our dependence on others to fulfill our basic energy needs.

If the people of this country agree on one thing about the energy crisis, it's that we have a serious problem. Whether there is a real energy shortage or a contrived shortage is not the point. We have a crisis because we've put all our eggs in one basket. Oil is a limited resource and a resource that can be manipulated by a handful of men—be they the oil ministers of OPEC, the executives who sit in the boardrooms of Big Oil or the politicians and bureaucrats who decide the policies and regulations that assure our continued dependence on oil.

We spend all our time arguing about who to blame for the energy crisis when the real culprit is our total dependence on a single energy resource.

We've developed such a gluttonous appetite for oil because it was traditionally the cheapest fuel to burn. It cost less than other alternatives so we built our economy upon it. Once we were totally dependent, guess what happened? The price shot straight up—a textbook example of supply and demand. OPEC and Big Oil have the oil and we need it so we'll pay anything to get it. If you don't agree, stop and think about how much you're paying for fuel now compared with just a few years ago. Convinced?

It's frightening when you stop to think about our dependence on this single resource. American mechanized agriculture must have gasoline and diesel fuel to plant, cultivate, harvest and transport crops and livestock. In addition, there are all the fertilizer, pesticides and other agri-chemicals that are derived from petroleum and natural gas. All truck and rail transportation in this country, which is the lifeblood of our economy, depends upon an uninterrupted supply of diesel fuel. All air travel for business and pleasure is powered by aviation gas or kerosene (from petroleum). All inland waterway shipping, vital to the transport of grain and bulk commodities (including coal for power plants) depends on diesel power.

Even our export of agricultural and industrial products to the rest of the world depends on diesel-powered shipping.

Needless to say, driving 55 mph, car pooling, making fewer trips to the store and cutting back on pleasure driving is a drop in the barrel compared with our total consumption of petroleum derived fuels. Conservation does nothing to change our dependence on oil. It only prolongs the agony.

What we need are cheap, safe, diversified energy alternatives.

What alternatives do we have? Ask a nuclear engineer and he or she will tell you nuclear is the only way to go. Obviously, you can't power a tractor, car or truck with a nuclear reactor but you can build nuclear generating plants to make electricity. The electricity can then be used for industry and for charging battery-powered vehicles. The idea is to reduce some of our dependence on oil. But stop and look at the consequences. Besides a highly questionable track record of operating safety and the potential for a serious environmental disaster, nuclear energy requires the indefinite storage of highly radioactive wastes that will remain deadly for thousands of years. Nobody wants those wastes buried in their backyard. Future generations will have enough problems without inheriting a nuclear timebomb.

But what's worse is that nuclear energy is just trading one kind of dependence for another. Like petroleum, it's high technology. It's beyond the average person's ability to comprehend. It's a multi-billion dollar corporate scale venture subject to the same kind of manipulation and control prevalent in the petroleum industry.

Building dozens of additional nuclear generating plants like those at Three Mile Island is not an acceptable or realistic answer. Who could guarantee an uninterrupted flow of uranium ore from abroad to fuel these additional plants? Would the uranium producing nations form a cartel once our total dependence on nuclear energy was assured? You bet they would.

Breeder type reactors are not the answer either. These are a class of reactor that "breeds" or makes more fuel than they use. Sounds like something for nothing, doesn't it? The catch is that breeder reactors still have all the same operating hazards as regular reactors, plus they make large amounts of plutonium isotopes. Plutonium, in case you didn't know, is one of the deadliest and most toxic radioactive wastes known. It remains

radioactive for millions of years, it is harmful to life in concentrations as small as a few parts per billion, and it is also the preferred ingredient for making nuclear weapons. So much for breeder reactors.

Another so-called solution to the energy crisis is synthetic fuel. Big Oil, coal interests and others propose to solve our long-term energy needs by keeping us dependent on gasoline and diesel fuel. They'll make the stuff synthetically from coal, natural gas, oil shale, tar sands or heavy crudes using the wizardry of modern chemistry. Whether or not synthetic fuels will prove to be economical is not as important a question as who will control the resource. High technology synthetic fuel production is still a monopoly enterprise—beyond the control of those who would be dependent upon it. There are also major environmental questions to be resolved. Should we strip mine large areas of the western United States and poison their limited water resources for the sake of a few more gallons of gas or should we rethink our dependence on oil and seek other alternatives? I opt for the latter.

There are a number of diversified energy sources easily within our grasp. These include alcohol, solar energy, wind power, geothermal, methane and hydrogen. Each has certain advantages and disadvantages. The method I believe to be the most practical and timely in terms of reducing our dependence on petroleum is alcohol.

Solar energy is fine for heating buildings, making hot water and generating electricity. Except for very specialized applications, electrically powered vehicles and farm tractors are as yet extremely impractical. The biggest problem with electric vehicles is storing sufficient energy in a small and lightweight space. This is something batteries do poorly but liquid fuels do quite well. Liquid fuels can be thought of as liquid energy. Unfortunately, you can't think of batteries as being solid energy. They're mostly bulk. They're also heavy and costly. Even some of the more exotic designs on the drawing board are still a long way from the energy density of gasoline or diesel fuel.

The typical electric vehicle of today is heavy, sluggish on acceleration, and has a very limited range. General Motors has taken a Chevette, crammed it full with about 1000 pounds of batteries, and called it the car of the future. It's lucky to make 100 miles on a charge.

The same car with a conventional gasoline engine can cover 100 miles on less than 4 gallons of gasoline—and keep right on going.

Another problem is that batteries must be replaced every few years or about every 20,000 to 30,000 miles. Replacement isn't exactly cheap. Batteries also suffer from corrosion problems and this makes preventative maintenance something of a chore. Batteries also take hours to recharge whereas a fuel tank can be refilled in a matter of minutes. Do you still think electrics are the coming thing? Not for a long time to come. Liquid fuels are much more efficient and convenient.

Wind power is another alternative often discussed. Like solar, it is ideal for generating electricity. Unfortunately it is useless for powering vehicles with conventional gasoline or diesel engines. For the wind to be of any use, a vehicle must first be converted to electric power at considerable cost. The wind can then be used to turn a generator to charge the batteries. But why go to all that effort when you can make a replacement fuel that will burn in your existing engine?

Geothermal energy is another possibility. It too can be used to heat buildings or generate electricity. But unless you've got a hot spring or volcano nearby, forget it.

What about hydrogen, the "clean burning fuel of the future"? Hydrogen can be extracted from water—by splitting water molecules into hydrogen and oxygen—with electricity. This process is called electrolysis. It's not terribly difficult to do, but most hydrogen projects have failed to show favorable economics. The process is still too costly to reasonably compete with other alternatives. It makes more sense to use the electricity directly than to use it to make hydrogen.

Hydrogen is also a highly explosive gas. Remember the Hindenburg? It was full of hydrogen when it crashed. Handling hydrogen requires special precautions as well as the use of pressurized storage tanks. A gasoline engine can be converted to run on hydrogen with good results, but not as easily as it can be converted to run on alcohol.

How about methane? Like alcohol, methane is a home-grown fuel that can be made from biomass or other organic wastes such as manure, grass clippings or even municipal garbage. Methane is fairly simple to make and it is an ideal fuel for heating, cooking or powering stationary engines. For use in a vehicle or farm tractor, it requires the addition of a pressurized

fuel system and a modified carburetor capable of handling the gaseous fuel.

Are there any other alternatives? Some people have suggested a return to animal power or human muscle power. True, we can reduce our dependence on machines somewhat—but try farming 900 acres with a mule and plow. Such a philosophy might work in developing nations where agriculture and transportation have not yet become as energy intensive as our own. Returning to such a way of life would be a monumental undertaking that would require drastic changes in lifestyles, technology and society itself. It's doubtful the population of an overcrowded world already plagued with malnutrition could survive without mechanized agriculture.

The best alternative to megabuck technology—spending more to receive less, overdependence on a limited resource or a potential collapse of our entire way of life—is to develop the abundant energy resources we already have. All the cheap oil is gone. The only way to sustain our petroleum diet is to drill deeper, search out every marginal oil field and spend millions figuring out new ways to make oil from something else. Petroleum has lubed the wheels of our economy quite well but the honeymoon is over.

Alcohol alone won't solve the energy crisis, but it is certainly a step in the right direction. The more alternatives that we develop, the more balanced our energy diet will become.

Alcohol is a fuel you can make yourself. It's based on techniques thousands of years old and on equipment you can build yourself. It's a natural substitute for petroleum fuels in many instances and it is a viable alternative to the vicious cycle of higher prices and uncertain supplies.

Every gallon of foreign oil we continue to buy underlines our dependence on a non-renewable resource and further weakens our position in an energy-starved world.

Every gallon of oil bought at inflated prices, whether from foreign sources or our own domestic producers, further fuels the fires of inflation.

But every gallon of alcohol fuel we make for ourselves is one gallon closer to self-sufficiency and a new way of life.

The choice is yours.

Chapter 1
The Truth About Alcohol

The argument heard most often against using ethanol (alcohol) as a motor fuel, either straight or blended with other fuels, is that it just isn't practical. Opponents say alcohol won't work for a number of reasons: It's too difficult and time-consuming to make. We need our surplus crops for food, not fuel. Alcohol costs too much and will never be able to compete economically with gasoline, diesel oil or other synthetic fuels. Alcohol makes a poor engine fuel and causes more problems that it cures.

It seems that the anti-alcohol forces have no shortage of energy when it comes to criticizing what might be our only viable alternative to OPEC, Big Oil, rising prices and the increasing scarcity of conventional petroleum fuels. Whether or not alcohol will prove to be America's answer to OPEC depends on too many variables. I'm not about to tackle all the issues surrounding the future of alcohol, the feasibility of a national gasohol program and so on because these subjects are beyond the scope of this book. But one thing is for sure: Alcohol is a better answer to the energy crisis than the lack of answers we've had so far. With that in mind, consider some of the criticisms of alcohol and see how accurate they really are.

CRITICISM: MAKING ALCOHOL IS TOO DIFFICULT AND TIME-CONSUMING

If you think making alcohol sounds tough, try making your own gasoline. As you'll discover in the following chapters, making alcohol is a proven and relatively straightforward

process that is well within the abilities of most people. The key to making alcohol is a sound understanding of the procedures involved and the right equipment to handle the job. Anybody can build a still and anybody can mix the necessary ingredients (Fig. 1-1). Knowledge and skill are what separate the successful from the not-so-successful when it comes to making alcohol.

Like baking a cake, you don't just stir up the recipe, throw it in the oven and forget it. You have to control things such as time and temperature if you want the cake to turn out right. The same applies to brewing alcohol. That means controlling things like sugar content, pH and temperature. These are some of the aspects of the science of making alcohol that must be learned. I hope this book will guide you through the basics and help you avoid the pitfalls most beginners are likely to encounter.

The most time consuming part of making alcohol is the fermentation process. This is when the yeast is added to the mash to transform the sugars into alcohol. Fermentation takes several days to complete—but the yeast do all the work. Your only concern during this period is for the temperature within the fermentation vat. It shouldn't be allowed to rise too high, otherwise it will stop the yeast action. The solution is to install a simple automatic thermostat control that will regulate vat cooling.

You can spend as much time making alcohol as you wish, but the addition of a few simple controls can cut the time spent "babysitting" a still to an absolute minimum.

The single most important factor in efficient fuel production is building a still with sufficient capacity. The larger the still, the fewer the number of runs that are necessary to keep your fuel tanks filled. If a still is the proper size, you need only make alcohol an average of once a month. That's a schedule anyone should be able to live with.

CRITICISM: WE NEED OUR SURPLUS CROPS FOR FOOD

What do we have a shortage of in this country, food or fuel? If you guessed food, guess again. The United States usually produces about 2.5 billion bushels of surplus grain annually and takes another 1.3 billion bushels of grain out of production each year as part of the U.S. Department of Agriculture's set-aside program. We have a tremendous agricultural potential in this country. As a result, our over-production forces the government to support crop prices. Year after year, farmers are faced with

fluctuating markets and prices that always seem to be far less than they should be. And year after year, more farmers are calling it quits. Using only a portion of our great surplus could bring change to that.

Even the Department of Agriculture has indicated "There is a good argument for supporting grain prices by maximizing production and converting surpluses to ethanol fuel, rather than by idling land."

What about the food shortage in the rest of the world?There's no shortage of hungry mouths to feed and little shortage of carbohydrate to fill bloated stomachs. The real shortage is protein. Making alcohol only involves the carbohydrate portion of the grain and not the protein. Only the sugars and starches are fermented into alcohol. This leaves a high-protein concentrate called distillers dried grain and solubles (DDGS). Commercial distilleries package and sell this product as an animal feed supplement or for human consumption. This

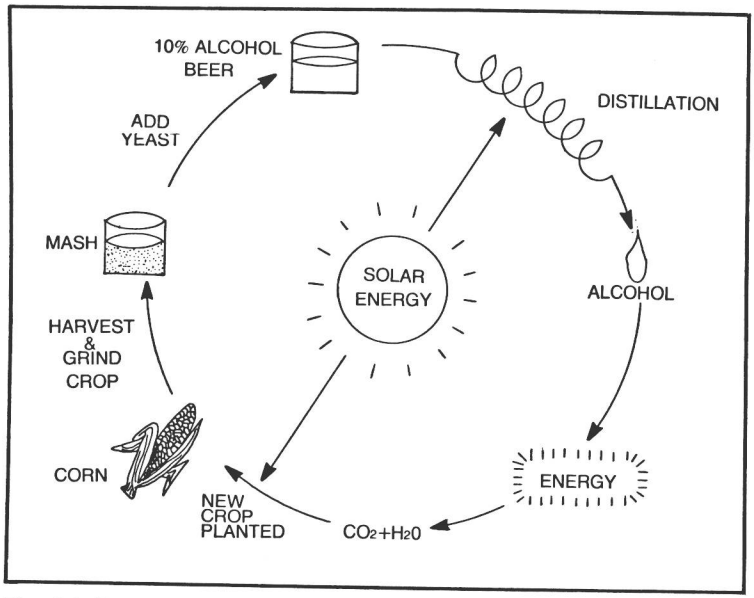


Fig. 1-1. Energy cycle for a renewable energy resource such as corn. Through the process of photosynthesis, plants take atmospheric CO_2 and water to build sugars, starches and cellulose. The crop is then harvested, ground and made into mash. Yeast is added to the mash to ferment the sugars into alcohol. Solar energy can then be used to distill the alcohol from the beer. When the alcohol is burned as fuel, the stored energy is released and the waste products are returned to be used over again.

same residue from your still can be fed wet to livestock or spread on fields as fertilizer.

Another fact to consider is that alcohol can be made from damaged crops and waste materials that might otherwise never be used. These include citrus fruit peelings, mildewed grain, cheese and whey. Alcohol can also be made from non-food sources such as corn stalks, plant leaves, wood pulp and even municipal garbage. Although converting such high cellulose materials into alcohol really isn't practical on a small scale, it does illustrate the fact that there are abundant resources for making alcohol all around us. These resources can be used without producing a negative impact on our human and animal food supply.

What's more, alcohol is a renewable resource. There are no wells to run dry and no mines to peter out. We can grow what we need year after year.

When gasoline or diesel oil is burned, we are using up stored energy that was created long, long ago. Not so with alcohol. The living plants from which alcohol is made represent new energy. They are the on-going product of the sun, the earth and photosynthesis.

Plants use sunlight to convert moisture, atmospheric CO_2 and nutrients in the soil, into starches, sugars and cellulose. The end products of photosynthesis can be harvested and made into alcohol.

There is a real concern among scientists that we might seriously upset the earth's balance of atmospheric CO_2. Burning fossil fuels generates great quantities of CO_2. One theory suggests that at our current rate of energy consumption, the accumulation of excess CO_2 will eventually create a "greenhouse effect." The earth will retain more heat than it normally radiates into space. The result will be a gradual rise in worldwide temperatures. This could melt the polar icecaps, upset global weather patterns and have a disastrous impact on world crop production.

Obviously, switching more of our energy emphasis over to alcohol won't solve the problem, but it will give us more time to make the transition from the fossil fuel age to the coming solar age.