

Oil-Related: Used Oil

COMMODITY PROFILE

North Carolina Department of
Environment and Natural Resources
DIVISION OF POLLUTION PREVENTION
AND ENVIRONMENTAL ASSISTANCE

MARKETS ASSESSMENT 1998



OVERVIEW

According to the American Petroleum Institute (API), each motor vehicle in North Carolina is responsible for the sale of an average of four gallons of lubricating oil per year.¹ With nearly six million industrial, commercial, and passenger vehicles registered with the state Division of Motor Vehicles, more than 21 million gallons of oil were sold in North Carolina in 1997. Despite the 1990 ban on oil disposal in North Carolina landfills, only 68 percent of all used oil generated in 1997 was recovered. After accounting for unrecoverable oil due to leakage or engine consumption, more than four million gallons of used oil are either being disposed improperly throughout the state or are unaccounted for in the 1997 data.

Opportunities to recover this “lost” oil exist. According to oil recycling companies in the Southeast, the two markets for used oil $\frac{3}{4}$ re-processing into fuel and re-refining into lubricant $\frac{3}{4}$ show strong growth potential during the next

five years. More significantly, experts indicate that the current supply of re-processed fuel from used oil already lags behind demand, thus creating an immediate opportunity to improve used oil recovery and marketing.

In addition, contamination from improperly disposed oil presents a threat to the state’s environment and natural resources. In its research on the potential impacts of used oil, the United States Environmental Protection Agency (EPA) has identified several environmental risks posed by improper disposal methods. For example, the EPA estimates that one gallon of used oil can pollute more than one million gallons of drinking water. Small amounts of used oil that accumulate on water bodies also can prevent oxygen and sunlight from entering the water, thus reducing the plant and animal life in lakes, ponds, and rivers. Additionally, used oil dumped in drains often accumulates in very small concentrations in water treatment plants and inhibits sewage treatment processes.²

Figure 1: Total Lubricating Oil Sold for Motor Vehicle Use in North Carolina 1993, 1997, and 2002

	1993 gallons	1997 gallons	2002 gallons
Total for Motor Vehicle Uses	19,898,461	21,637,629	22,995,755
A. Other Motor Vehicle Consumers	9,949,230	10,818,815	13,797,453
B. Do-It-Yourself Sources	9,949,231	10,818,814	9,198,302

Source: Based on data from the American Petroleum Institute, *National Used Oil Collection Study*, May 1996.

This report analyzes the relationship between the supply and demand for used oil in North Carolina. The analysis focuses primarily on identifying the sources of used oil with the greatest potential for increased recovery and with the most accessible markets for re-refining and re-processing.

The definition of used oil is taken from the California Public Resources Code and includes any oil that was used in an internal combustion engine crankcase, transmission, gearbox, or differential in an automobile, bus, truck, vessel, plane, train, heavy equipment, or other machinery powered by an internal combustion engine.³

SUPPLY

Generation

Data were lacking on used oil generation and consumption in North Carolina. For this reason, generation is calculated in three steps. The first step involves estimating the amount of oil sold in North Carolina during 1997. Second, the consumption of oil is allocated to different types of oil consumer groups. Finally, the amount of oil allocated to each consumer category is then reduced by a factor that accounts for non-recoverable oil because of burning, leaking, and other influences.

Step One: Oil Sales

To estimate the amount of used oil sold, the number of vehicles registered by the Division of Motor Vehicles for 1997 was multiplied by the average gallons of oil used annually per vehicle from the API study.⁴ To estimate gallons sold in North Carolina, 5.8 million vehicles was multiplied by 3.677 gallons per vehicle per year to yield an estimate of more than 21 million gallons of oil sold for use in motor vehicles in 1997 (Figure 1).⁵

Step Two: Consumer Groups

The two main categories of oil consumption from motor vehicle sources are do-it-yourself (DIY) oil changers and all other motor vehicle (OMV) consumers. DIY generators consist primarily of people who change their own oil at residences and, thus, are responsible for disposing their used oil. OMV generators constitute a broad class of consumers including people who bring their automobiles to quick oil

change facilities, dealerships, or service stations. In addition, the OMV category includes used oil generated from commercial and government fleets, rental car operations, and other establishments that generate used oil.

As indicated previously in API studies, DIY oil changers constitute approximately 50 percent of the motor vehicles and used motor oil generated in North Carolina. This assumption is based on a national average and may underestimate the percentage of DIY oil changers in North Carolina. The state exhibits three characteristics that make a higher portion of DIY changers likely: 1) a more rurally based population, 2) a warm climate, and 3) a younger population (older Americans are less likely to change their own oil).⁶ However, because of the increasing urban population and continued expansion of quick oil change outlets, the percentage of DIY oil changers is expected to decrease two to five percent per year in the short term future.⁷ The estimations for 2002 in this report reflect a two-percent annual decrease in the percent of DIY consumers.⁸

Calculations for the total used motor oil sold in North Carolina in 1997 are based on the average per vehicle oil sales estimates from API's *National Used Oil Collection Study* in 1996. As demonstrated in Figure 1, the used oil sales from motor vehicle sources increased from 19 million gallons in 1993 to more than 21 million gallons in 1997. This increase is attributable to an increase in population of the North Carolina and an increase in vehicles per capita since 1993.

Step Three: Recoverable Used Oil

As illustrated in Figure 2, an oil recovery factor is incorporated to account for unrecoverable oil. This factor is applied to the total gallons sold to account for leaking, burning, unused oil left in bottles, and residue left in filters. As a result, only 60 percent of oil sales to DIY oil changers is available for recovery. It is estimated that 65 percent of oil sales to OMV are available for recovery due to newer vehicles in commercial fleets and stronger standards for filter drainage.⁹ Accounting for unrecoverable oil from both DIY and OMV sources, more than 13 million gallons of used oil were generated in North Carolina in 1997.

Figure 2: Generation of Used Oil from Motor Vehicles (Accounting for Unrecoverable Oil)

	1993 gallons	1997 gallons	2002 gallons
Total Oil Sold for Motor Vehicle Uses	19,898,461	21,637,629	22,995,755
1. Sales to Other Motor Vehicle Consumers	9,949,230	10,818,815	13,797,453
Recoverable Used Oil from OMV (65%)	6,467,000	7,032,230	8,968,344
2. Sales to Do-It-Yourself Sources	9,949,231	10,818,814	9,198,302
Recoverable Used Oil from DIY (60%)	5,969,539	6,491,288	5,518,981

Figure 3: Total Used Oil Recovered from All Motor Vehicles in North Carolina 1997 and 2002

	1997 gallons	2002 gallons
Generated and Recoverable Motor Vehicle Used Oil	13,523,518	14,487,325
Government Recovery (local and state)	824,362	915,742
Private Sector Recovery	8,213,758	9,803,533
Total Recovery	9,038,120	10,719,275
Percent Recovered	67%	74% (assumed)
Unaccounted for Used Oil	4,485,398	3,768,050

Figure 4: Other Motor Vehicle (OMV) Used Oil Recovered in 1997 and 2002

	1997 gallons	2002 gallons
Recoverable OMV Used Oil Generated	7,032,230	8,968,344
State Fleet Government Recovery	248,503	316,921
Private Sector Recovery	6,633,831	8,460,258
Total Recovery	6,882,334	8,777,179
Percent Recovered	98%	98% (assumed)
Unaccounted for OMV Used Oil	149,896	191,165

Recovery

Available data indicate that 67.8 percent of recoverable motor vehicle used oil was collected in North Carolina in 1997 (Figure 3). A majority of the nine million gallons of used oil recovered from motor vehicles was collected from private sector sources. In fact, used oil from commercial fleets, quick oil change outlets, and auto parts stores accounted for more than seven million gallons of used oil recovery in 1997. Local governments accounted for an additional 575,859 gallons. Approximately four million gallons of used oil remain unaccounted for and were possibly disposed of illegally.

To discover the potential sources of unrecovered used oil, it is necessary to analyze the recovery to OMV and DIY oil streams separately. As noted in Figure 3, the future of the used oil recovery level should increase as the industry con-

tinues to shift from DIY changers to quick-change outlets.

Other-Motor-Vehicle Sector

Based on information gathered from North Carolina's four largest private sector recovery sources, the used oil recovery from OMV sources occurs almost exclusively through private sector channels. For example, while the state government recovered almost 250,000 gallons of used oil from government fleets in 1997, private sector channels recovered more than 6.6 million gallons. In combination, the recovery rate for used oil from all OMV sources reached 98 percent of generation in 1997 (Figure 4).

Do-It-Yourself Sector

Despite the same amount of used oil generated as the OMV sector, the DIY sector achieved a 35-percent recovery rate in 1997. Local government collection of used oil, which is

almost exclusively DIY oil recovered at landfill collection sites, increased from 500,000 gallons in 1996 to more than 575,000 gallons recovered in 1997. While local government recovery at landfill sites was more than 575,000 gallons, private sector recovery also accounted for roughly 1.58 million gallons of used oil from DIY sources. While some private sector recovery of DIY oil may not be included in this report, the data reveal that the DIY sector was responsible for more than four million gallons of unaccounted for used oil in 1997 (Figure 5). Because of increased accessibility of quick oil change outlets, industry experts estimate that the DIY share of the consumer market will decline by two to five percent per year in the near future.¹⁰ By 2002, the quantity of oil generated by DIY oil changers will decrease to five million gallons as their market share decreases from 50 to 40 percent.

In addition to conventional used oil calculations, approximately 3.5 to eight ounces of used oil is contained in oil filters, depending on drainage practices. Assuming that the best possible drainage practices are employed, more than 270,000 gallons of used oil was disposed in North Carolina landfills along with approximately 10 million used oil filters in 1997.¹¹ Moreover, an average of 0.8 ounces of oil is trapped in every discarded one-quart bottle of oil used for motor vehicle lubrication purposes. In other words, an additional 270,000 gallons of oil was disposed in North Carolina landfills because of the residual oil left in oil bottles from DIY oil changes.¹²

Source Reduction

Fewer oil changes means less waste oil released into the environment. Because of improvements in the design of motors during the past 10 years, most of the major automobile manufacturing companies have decreased the recommended frequency of oil changes. For example, Ford Motor Company has increased the minimum mileage between oil changes from 3,000 miles to a minimum of 5,000 miles. Similarly, Toyota now suggests that owners change their motor oil every 7,500 miles, except under severe driving conditions.¹³ If vehicle owners followed the lowest of the new standards for less frequent oil changes (Ford's 5,000 miles), there could be a significant reduction in the generation of used oil in the state of North Carolina. More specifically, an increase in the minimum distances between oil changes of 2,000 miles (to 3,000 - 5,000) could result in as much as a 30-percent reduction in the generation of used oil, or roughly four million gallons in 1997.

Increasing Recovery

Many states have initiated used oil recycling programs based on the API Model Bill. This model bill establishes the guide-

lines for a state-used oil fund supported by a fee on oil sales (usually two cents per quart). The fund normally is used to provide grant funding for cities and towns that wish to establish and publicize used oil drop-off centers or curbside collection programs. In addition, many states use the funds to support a toll-free telephone information center and state sponsored promotions. South Carolina uses some of its state funds to provide a multi-media advertising campaign, which includes print materials, a school curriculum, and television and radio advertisements with NASCAR celebrities. Many of the state's educational programs are focused on raising the awareness of DIY oil changers.

To better focus the South Carolina recycling campaign, the Institute of Public Affairs at the University of South Carolina conducted a survey of DIY oil changers in 1993. The survey revealed that approximately 49 percent of the market consisted of DIY oil changers. The research also indicated that individuals with the greatest tendency to illegally dispose used oil were generally between 18 and 45 years old, had a lower educational level than the state average, and had family incomes below the state average. These findings helped in the siting of collection centers and influenced the content of the educational campaigns.

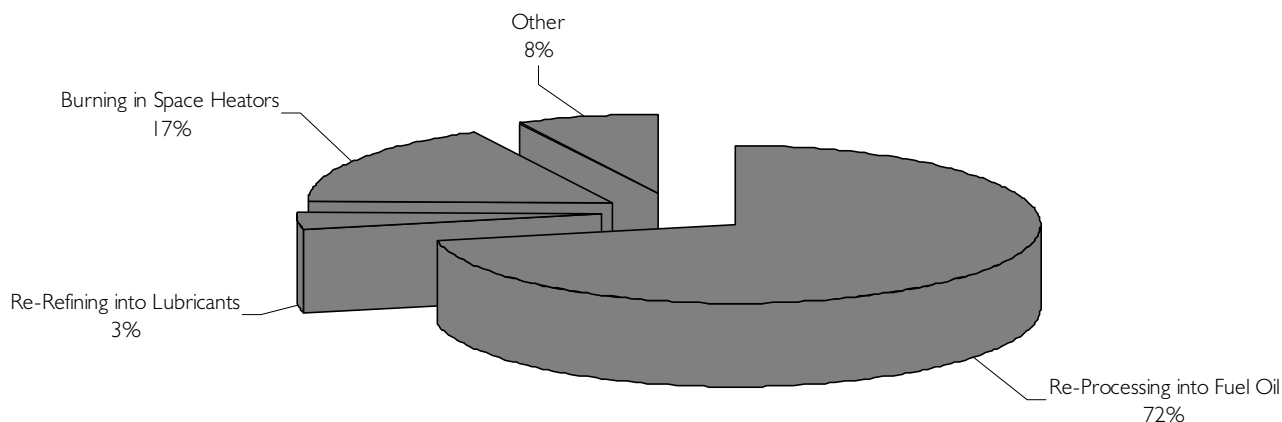
North Carolina has established the need for used oil recycling programs in state statute. In General Statute Act 309.16, the state proposed to support a public education program regarding used oil collection and recycling through the provision of financial and technical resources. In General Statute Acts 309.21 and 22, the state also committed to provide funding and expertise necessary to initiate an incentive program for individuals who change their own oil. In addition, the Statute proposed supporting a grants program to encourage new local government curbside collection initiatives and the establishment of additional private used oil collection centers. Funding was never appropriated for these programs, therefore they were never implemented.

Another way to increase oil recovery is to target "hidden" sources. For example, an average of 0.8 ounces of oil is trapped in every one-quart bottle of oil sold. In other words, in 1997, approximately 270,000 gallons of oil was disposed in North Carolina landfills because of residual oil left in bottles after oil changes. Similarly, assuming that best possible drainage practices were employed in 1997, more than 270,000 gallons of used oil were still disposed along with 10 million used filters in 1997. By addressing these hidden sources, North Carolina could dramatically decrease the amount of used oil disposed in landfills.

Figure 5: DIY Used Oil Recovered in 1997 and 2002

	1997 gallons	2002 gallons
Recoverable DIY Used Oil Generated	6,491,288	5,518,981
Local Government Recovery	575,859	598,821
Private Sector Recovery	1,579,927	1,343,275
Total Recovery	2,155,786	1,942,096
Percent Recovered	33%	35% (assumed)
Unaccounted for DIY Used Oil	4,335,502	3,576,885

Figure 6: National Distribution of Demand for Used Oil Products



* Based on survey conducted by API, May 1996.

DEMAND

This section focuses primarily on the demand for used oil from North Carolina's two largest end users: re-processing fuel and re-refining lubricants. API defines re-processing as cleaning used oil so it can be reused as a fuel to produce electricity. Re-refining, on the other hand, requires additional treatment so that spent oil can be used again as petroleum based oil. Re-processed used oil is not of sufficient quality to be used for lubrication purposes.¹⁴ According to the *National Used Oil Collection Study* conducted by API, roughly 72 percent of the used oil generated nationally is re-processed into fuel (see Figure 6). API also reports that space heaters consume roughly 17 percent of used oil, particularly in northern states with severe winters. In addition, API estimated that 3.5 percent of used oil was re-refined into lubricating oil.¹⁵

Fuel Oil Markets

A majority of used oil in North Carolina is used to produce fuel oil for industry. In most oil recycling and fuel production operations, used oil is re-processed by removing con-

taminants and adding virgin oil to produce oil suitable for burning in industrial boilers.

Noble Oil Services maintains an oil recovery and processing facility in Sanford, North Carolina. Currently, the plant produces more than 100,000 gallons of fuel per day. In 1997, Noble Oil accounted for more than six million gallons of used oil recovery in North Carolina. More importantly, Noble Oil perceives that the demand for fuel from used oil has the potential to match a large increase in supply of recovered used oil. Noble Oil Services anticipates that it could increase its consumption of used oil 100 to 200 percent if used oil recovery were to increase in the future.¹⁶ Holston Group Inc. also produces fuel from used oil in North Carolina and expects similar growth in end-use market demand.

Lubricant Markets

Safety Kleen is the largest re-refined lubricant producer in the nation. Safety Kleen collects used oil from North Carolina and other parts of the United States and re-refines it into

lubricant at its processing facility in Chicago, Illinois. The amount of used oil processed at the Chicago plant has increased from 75 million gallons in 1994 to more than 100 million gallons in 1997. Roughly 90 percent of the re-refined oil is resold as recycled lubricating oil for industrial, railroad, government, and passenger motor oil purposes. The remaining 10 percent enters the fuel market. While the national sales of all lubricating oils have remained fairly constant for the past three years, Safety Kleen estimates that the re-refined motor oil market has enormous growth potential. The company estimates sales could double during the next five years because of continued growth in the industrial and railroad markets, the emergence of closed loop oil management systems for government sector contracts, and increasing “buy recycled” customer awareness programs in the DIY market. While Safety Kleen’s recycled motor oil has traditionally sold to industrial and railroad consumers, its recent contracts with federal, state, and local governments have increased the acceptance of re-refined oil as a viable market with growth potential. Currently, Safety Kleen estimates that re-refined lubricant oil constitutes three percent of the total lubricant market sales.¹⁷

SUPPLY / DEMAND RELATIONSHIP

The demand for recycled used oil products is heavily influenced by the price and demand trends in the virgin crude oil market. For instance, fluctuations in the price of crude oil directly impact the price competitiveness and demand for used oil products. The price of crude oil fluctuates according to international political and economic events and oil producers’ strategic decisions regarding supply. During the past three years, the market for used oil has become increasingly competitive because of virgin crude oil glut in the world market. When virgin oil prices peaked in 1996, producers responded by increasing crude oil supplies to realize greater profits. The market soon experienced a glut of oil, thus driving crude oil prices back down. As the price of crude oil has continued to decrease since 1997, the market for used oil has become increasingly competitive.¹⁸

Some key differences are evident between the markets for recycled fuel oil and re-refined lubricant oil. In the fuel oil market, for example, re-processing used oil requires less energy than refining virgin crude oil. As a result, used fuel oil has traditionally provided competitive prices relative to crude-based fuel oil products. Therefore, despite the decrease in price of crude oil in the world market, recycled fuel oil has maintained a relatively stable demand structure. In contrast, the process of producing re-refined lubricating oil does not provide significant cost savings relative to crude oil products. Consequently, for more than the past two years, the demand for re-refined lubricating oil has become

increasingly competitive. In response to this increased competitiveness, Safety Kleen has shifted its emphasis from strictly base stock lubricant production to higher quality lubricant products, which require more processing and are less vulnerable to the price cutting trends in the crude oil market.¹⁹

Based on market analyses from processors of re-refined lubricant oil and especially from recycled fuel oil producers in North Carolina, there appears to be a strong potential for an increase in the short-term demand for used oil. More specifically, processors of fuel oil in North Carolina indicate the demand for fuel oil already exceeds current supply levels.²⁰ Similarly, as Safety Kleen continues to realize growth in the industrial, rail, and government sectors, the demand for re-refined lubricant oil should also increase in the near future. Based on this information, it appears that the current and future demand for used oil provide the potential to absorb significant increases in the supply of used oil from both the DIY and OMV sectors.

Based on current data, the total recovered used oil from motor vehicle sources was more than nine million gallons in 1997. Given the significant amount of used oil that is not collected from DIY sources, this recovery rate can be characterized as below the potential supply capacity. In fact, with more than four million gallons of uncollected used oil from DIY sources, there appears to be significant potential for an increase in supply. In summary, it appears that the potential demand for fuel oil is more than adequate to absorb a significant proportion of the more than four million gallons of unrecovered used oil from DIY sources.

CONCLUSION

Based on the current indications of strong demand for used oil as a fuel product, North Carolina has an opportunity to recover much of its remaining used oil. In particular, the state should focus on increasing the recovery of used oil from the DIY generation sources. In addition, by increasing public awareness of higher oil change intervals, the amount of used oil generated could decrease significantly. Moreover, with projections of continued population growth in North Carolina during the next few decades, the issue of proper oil management and treatment will become increasingly important for preserving the integrity of North Carolina’s natural resources.

RECOMMENDATIONS

The following recommendations are based on the study of generation, recovery, and markets for used oil presented in this section.

- North Carolina should research its locations, characteristics, and disposal behavior patterns of DIY oil changers.
- The state should support an education campaign to raise the awareness of proper oil disposal methods and to increase the proliferation and visibility of public and private drop-off collection sites.
- State and local governments also should seek opportunities to link used oil bottle collection efforts with used oil and oil filter recycling programs.
- State and local governments also should educate citizens on the possibility of decreasing the frequency of oil changes through higher oil change intervals. This campaign should target both DIY changers and other vehicle owners equally.
- To measure the effectiveness of oil recycling efforts, a data collection system should be established to monitor the quantity of oil sold and the amount of used oil recovered.
- To recover a portion of the DIY oil stored at rural households and farms, local governments should sponsor rural oil collection events. While the actual quantity of used oil generated from rural sources is currently unknown, several rural collection events have resulted in significant collection quantities. For example, more than 1,500 gallons of used oil was collected on a rural collection day outside Greensboro in the early 1990s.
- To demonstrate leadership and bolster the demand for re-refined used oil, the state should use only re-refined used oil in its motor vehicle fleets. Local governments should be encouraged to follow this example.
- Finally, because of tremendous need for public education efforts to improve the recovery rate of used oil from DIY sources, the state should seek to fulfill the responsibilities established in the North Carolina General Statutes 130A-309.16 and 309.21-22.

¹ American Petroleum Institute. *National Used Oil Collection Study*. May 1996. p. 36.

² U.S. Environmental Protection Agency. *Environmental Regulations and Technology. Managing Used Motor Oil*. December 1994. p. 4.

³ According to the California Public Resources Code, Section 48618, lubricating oil includes any oil that is intended for use in machinery powered by an internal combustion engine. Lubricating oil includes oil intended for use in an internal combustion engine crankcase, transmission, gearbox, or differential in an automobile, bus, truck, vessel, plane, train, heavy equipment, or other machinery powered by an internal combustion engine. Lubricating oil does not include oil intended for use in a two-cycle engine where the oil is consumed entirely during usage. From *National Used Oil Collection Study*. May 1996. p. 160.

⁴ The vehicles registered category included automobiles, trucks, buses, state vehicles, tractor trucks, and recreation vehicles from the total list of vehicles registered in 1997 provided by the Division of Motor Vehicles.

⁵ According to research by the API, the average motor vehicle in North Carolina purchases 3.677 gallons of oil per year. (API. *National Used Oil Collection Study*. 1996. p. 36).

⁶ American Petroleum Institute. *National Used Oil Collection Study*, p. 35. May 1996.

⁷ Communications with the Automobile Oil Change Association. October 1998.

⁸ Communications with Automotive Oil Change Association. October 1998.

⁹ These estimates for recoverable oil for DIY and OMV sources are based on information from the California Environmental Protection Agency Integrated Waste Management Board. Communications with Bob Boughton. August 1998. In the *National Used Oil Collection Study*, the API estimated recoverable used oil from DIY sources at 70 percent.

¹⁰ Communication with the Automotive Oil Change Association. October 1998.

¹¹ Communication with Bob Boughton and the California Environmental Protection Agency Integrated Waste Management Board, Communications. August 1998.

¹² Communication with Kathy Carmichael. KC and Associates. October 1998.

¹³ Toyota recommends that most cars and trucks follow normal oil change procedures of 7,500 miles. However, some vehicles, which fall under severe driving condition criteria, should have their oil changed more frequently (3,750 miles). The following criteria determine severe driving conditions; 1) towing a trailer, using a camper, or car top trailer; 2) operating on dusty, rough, muddy, or salt spread roads, 3) repeated short trips less than less than five miles and outside temperatures remain below freezing, 4) extensive idling and/or low speed driving for a long distance such as police, taxi, or door-to-door use.

¹⁴ American Petroleum Institute. *National Used Oil Collection Study*. p.40, May 1996

¹⁵ American Petroleum Institute. *National Used Oil Collection Study*. p.40-42.May 1996

¹⁶ Communications with Jim Jolliff. Noble Oil Service. October 1998

¹⁷ Communication with David Peel. Safety-Kleen. November 1998.

¹⁸ Communication with Noble Oil Services and Safety Kleen. November 1998.

¹⁹ Communication with David Peel. Safety-Kleen. November 1998.

²⁰ Communication with Noble Oil Services and Holston Group Inc. September and October 1998.