

END OF LIFE BOAT HULLS –THE CURRENT SITUATION AND DISPOSAL OPTIONS

Kathleen Stevenson

School of Civil Engineering and the Environment

University of Southampton

Southampton

SO17 1BJ

Word Count: 6999

Abstract

With pressure on EU countries to recycle more and landfill less, waste management is becoming sector specific to recover reusable materials before they are sent for final disposal. The introduction of producer responsibility plays an important role in this. This study investigates abandoned leisure boats in the Southampton Water area in two parts: (a) Is there a problem and how is it dealt with? (b) How to solve the problem. Particular attention was paid to Fibre Reinforced Plastic (FRP) hulls. Semi structured interviews and site observations were conducted with relevant people. No research has been undertaken in this area before and an attempt to quantify the problem proved impossible. The main issues uncovered were the difficulty in tracing owners due to the lack of boat registration and the problems associated with recycling FRP. Even if economy was no barrier to recycling FRP the lack of information about boat material would be, as applying appropriate techniques would be impossible. Current legislation does not address the issue and the polluter can not be charged for fly tipping. It is recommended that a system is developed to record numbers of abandoned boats to assess problem areas and a deposit – refund scheme is developed. This way even if registration and recycling are not introduced responsible disposal would be encouraged by way of a financial reward.

Keywords

Boats

Producer Responsibility

Waste Management

Fibre Reinforced Plastic

Recycling

Refund – Deposit Scheme

1. Introduction

In today's world of increased environmental awareness waste management is emerging as an important issue concerning resource usage and environmental protection. The Waste Framework Directive 1975 (article 1(a)) defines waste as 'any substance or objectwhich the holder discards or intends or is required to discard' (Bell and McGillivray, 2006). The route of final disposal in landfill is the most undesirable option, not only because of the waste of potential resources but also due to lack of space. Pressure to divert specific materials from landfill has been put on EU Member States in the form of the 1999 Landfill Directive. This has led to a need to readdress the waste hierarchy. Reducing, reusing and recycling waste are the preferable options that will develop sustainability.

Many components of the waste stream require management techniques specific to their composition and volume. Legislation such as the End of Life Vehicles Directive (ELVD) and the Waste Electrical and Electronic Equipment (WEEE) Directive address and introduce the concept of producer responsibility which detail percentages of the waste materials that must be recycled and reused. Householders are being encouraged to take responsibility for their own waste arisings with some countries introducing 'pay as you throw' schemes to charge for excess household waste put out for disposal (Karagiannidis *et al.*, 2006).

This project examines end of life boat hulls as a waste, in particular hulls made of FRP for the reasons discussed below. The distinction between ships and boats is often unclear, for the purposes of this study vessels used for leisure are targeted. DEFRA is already working on plans to 'green' the breaking of commercial ships and possibly introduce ship recycling facilities in the UK (DEFRA, 2006).

1.1 Characteristics of FRP

According to Scott (1996) 'FRP became popular as a building material for leisure boats in the 'small boat boom' of the 1950s and 60s'. Many sources (du Plessis, 2002, Parkyn, 1970 and Scott, 1996) identified FRP as being ideally suited to boats due to it being lightweight, strong, watertight, easy to maintain and impervious to the marine environment.

FRP used for leisure boats is a composite of c. 80% liquid plastic resin (polyester, sometimes epoxy) dispersed through c. 20% thin fibre filaments, which can be woven to produce a thin mat of fibres. Fillers (generally polyester) are used to extend the resin use (du Plessis, 2002). In boat building glass is the most popular fibre used as it 'does not absorb water (and therefore swell and rot), has a high heat resistance and does not burn' (du Plessis, 2002). Two types of resin are used for FRP: thermoplastics, which can be melted down and remoulded, and thermosets which can not be melted (Conroy *et al.*, 2005 and Pickering, 2006). du Plessis (2002) confirms polyester and epoxy resins are thermosetting.

1.2 The problem with FRP

As observed by du Plessis (2002) 'construction is dominated more by production convenience than best boat practise. In particular, little consideration is given to what can be maintained, modified or repaired conveniently and cheaply in later years.' With 'steady developments' there are improvements on past models and new styles are continuously developed (du Plessis, 2002). Additionally, as Conroy *et al.*, (2005) noted, 'FRP components are economical to produce, and this counts against reuse of existing items if they require labour intensive inspection, cleaning, decontamination or repair.' As such people will invest in new boats rather than spend time and effort repairing existing ones. Ultimately this will result in unwanted boats, and moulds, that need to be disposed of. This trend is evident in cars with Marsh (2003) predicting the amount of end of life waste from FRP usage in the motoring sector in Western Europe to double from 150 kilo tonnes to 300 kilo tonnes between 2000 and 2015, the amount of FRP waste from production will stay constant.

The project will investigate the current situation of leisure boat disposal taking into account the problems of FRP and the potential rise in end of life FRP boats nearly 60 years after their initial introduction into the boating industry. Anecdotal reports from the Royal Yachting Association (RYA) (personal communication) suggest a tendency towards abandoning boats when they are no longer wanted. The project will seek to quantify and identify the problems these abandoned hulls present. Initial research by the RYA has shown limited information is available on the nature of the problem with regards to the following areas: numbers for disposal, material type of end of life hulls and disposal routes. The British Marine Federation (BMF) estimates there are 451 000 boats kept in the UK with 'up to 3.5 million people over the age of 16' participating in the use of leisure boats – about 3% of the

population. E composites (2005) predict an annual 7% rise in global demand for recreational boats over the next four years.

2. Area Description

The study areas chosen were the three main shipping and boating rivers that flow into Southampton Water (which in turn leads to The Solent); the Rivers Hamble, Test and Itchen. The River Hamble alone provides moorings for over 3000 boats (New Forest District Council, 2006), which is second only in the Solent to Chichester Harbour with over 5000 moorings. Southampton Water provides both sheltered water for learning and open water for cruising and the double high tide that the area experiences means two chances to launch a day. Transport infrastructure provides excellent links to the area allowing non – locals to use this area to moor their boats, which is a major boost to the economy of the area.

3. Method

The project was divided into two stages: (a) Is there a problem and how is it dealt with and (b) how to solve the problem. The main themes investigated for part (a) were: who is responsible for the abandoned boat, the numbers and types of abandoned boats, the problems they cause – environmental and economic and how disposal is addressed. Part (b) investigated current boat building practises and looked at the future of the industry to discover whether any thought is given to end of life hulls and how the problems of disposal could be lessened. Throughout the research semi-structured interviews were used to ‘understand the issues in the interviewee’s own terms’ (Flowerdew and Martin, 1997). The main themes of the research steered the interviews through intermittent questions whilst the semi-structured approach allowed expansion and discussion of the themes by the interviewees.

3.1 Is there a problem and how is it dealt with?

Interviews and site observations were conducted with boatyards and marinas along the River Hamble. The boatyards and marinas targeted were situated along the length of the river resulting in different tide heights. Marinas further up the river whose mooring use times are constrained by tides are cheaper than non-tidal marinas. Interviews sought to quantify and qualify the situation while site observations enhanced the understanding of particular problems by allowing visual observations of boats.

Harbour Masters of the three main rivers leading to Southampton water were also interviewed to gain an understanding of the problem on public waterways. For the Rivers Itchen and Test visual inspections of the waterways were made by boat. Local Authorities were also interviewed to assess the problem and regulation requirements on public land.

After discussion with one Harbour Master the research area was extended eastwards to Langstone Harbour to accommodate a particular area of concern. A survey of the beach was undertaken with the Environment Officer for the Harbour Authority to investigate the feasibility of data collection for the problem of abandoned boats. The length of the beach was walked along, at low tide, below the high tide mark. The numbers of seemingly abandoned boats above and below the high tide mark were counted and information was recorded for a selection of boats to illustrate the variances in characteristics of unwanted vessels. The information recorded was: Length, Material, Salvageable Parts

and Scale of boat's state (1 – Abandoned, 2 – Minor damage, 3 – Poor state, 4 –Breaking down, 5 – Wreck: un-sailable).

Regulatory Bodies (the Environment Agency (EA) and Maritime and Coastguard Agency (MCA)) were interviewed to assess the scope of the problem and their requirement to become involved with it. Owing to the larger scale of these organisations these interviews were conducted by telephone and email.

Domestic waste management companies were questioned, by telephone, as to the frequency and methods of disposal of boats and how much they would charge an individual. This route was taken to investigate a possible driver for boat abandonment and clarify disposal routes.

3.2 How to solve the problem

A semi-structured interview was carried out with a boat design representative of VT Halmatic, the pioneering users of FRP as a material for boat building. Their client base includes the RNLI and the MOD. The problem of end of life boats was discussed with regards to whether boat material could be recycled and how this would affect their business within the industry.

A semi-structured interview was conducted with Professor Shenoj, Head of Ship Science at the University of Southampton. This gave insight into boat building as a whole and the possibility of recycling boat-building materials from an impartial viewpoint. Discussion of issues such as material specifics, economics and legislation helped to put the problem into perspective.

4. Results

4.1 Is there a problem and how is it dealt with?

Little, if any information is recorded pertaining to abandoned boats and their characteristics, both on private and public land, moreover they are dealt with as they become apparent and there is the need to remove them. Only at the site of concern ('Site D' associated with Langstone Harbour) are the details recorded – due to the high numbers of unpaid harbour dues. Since exact figures and records are not kept there is little information to answer the initial questions and information recorded is thus treated with caution, Table 1 highlights the deficient information. Anonymity has been given to titles, names and areas to protect any current proceedings.

4.1.1 Who is responsible for the abandoned boat?

The person who deals with the abandoned boat is the owner of land it is found on, who ultimately also becomes responsible for the disposal and subsequent costs of the boat unless a 'polluter' can be found to pay. Figure 1 details the three main legislation routes taken.

Marinas The Environmental Code of Practice (BMF, RYA and EA) advises that the owner is responsible for the disposal of the hull. Interviews with four marinas/ boatyards (A - D) revealed common themes (Table 2). Although marinas will often bear the costs of disposal it is in their best interest to keep the site well maintained to encourage business and maintain a competitive edge.

Boatyard D used to be a breaking yard for all boats, but due to the labour intensity the high prices charged became too expensive for other marinas to use. Now it is used for boats abandoned at their site and all useable parts are salvaged to be sold in their chandlery. The interviewee of Shipyard A felt more expensive marinas are used for businesses to moor their boats (compared to the 'enthusiasts' that use cheaper options) and so are highly unlikely to result in abandoned boats. Initially this is because there is no where to leave the boat (e.g. no river bank) and due to the high prices paid - boats are unlikely to develop into an unsightly state.

Harbour Masters and Local Authorities Different scenarios and ways to approach the problem are encountered on public land. The Litter (Relevant Land of Principal Litter Authorities and Relevant

Crown Land) Order 1991, section 89(7) of the Environmental Protection Act (EPA) 1990 (Department of Environment, Transport and the Regions, 1999) states that ‘...land below the place to which the tide flows at mean high water springs is not to be treated as relevant land of principal litter authorities or as relevant Crown land’. This means Local Authorities have a duty to deal with litter above the mean high water mark and Harbour Masters with litter below it.

Local Authorities use the Refuse Disposal (Amenity) Act 1978 (Figure 1), which primarily deals with motor vehicles intended for use on roads, but section 2 states that ‘it is [also] an offence to abandon anything else that has been brought on to land for the purposes for abandoning it’ (DEFRA, 2006).

Harbour Masters use The Merchant Shipping Act 1995 (Office of Public Sector Information) (Figure 1); section 252 of which states the authority may move, remove, sell (and recover costs) or destroy: ‘...any vessel [which] is sunk, stranded or abandoned in or near any approach to, any harbour or tidal water under the control of a harbour authority or conservancy authority in such a manner as, in the opinion of the authority, to be, or be likely to become, an obstruction or danger to navigation or to lifeboats engaged in lifeboat service in that harbour or water or approach thereto...’. All Harbour Masters interviewed stated they would only deal with an abandoned boat if it were a shipping hazard or if harbour dues have not been paid. Under section 26 of the Harbours Act 1964, Harbours have the power to demand dues from the owners of vessels using the water (personal communication – Harbour Master C).

In the case of site D the Harbour Master will identify abandoned boats below the high water mark and process the paper work through a Harbour Order specific to the site; however the Local Authority will provide the waste disposal facility when needed – approximately every eight months. Discussion with the Environmental Officer revealed the main motivation for clearing boats from the beach was health and safety. There were so many lines securing boats along the beach they were hazardous for users of the beach. Often smaller boats are just moved up above the high water mark for the Local Authority to deal with, which is rarely (supported by the high numbers of tenders above the high water mark, Table 3). The area surrounding the remit of Harbour Master B has many rights of ways used by families with children so any abandoned boats are removed as soon as possible.

Regulatory Bodies The EA will only get involved if the boat is beached and a hazardous liquid (e.g. oil) is leaking out and causing pollution. Pollution from a floating vessel is the Harbour Master's remit. Harbour Masters often the MCA for details of boats and owners, which may be found on the Small Ships Register (SSR) (see later) if they are registered. Other than that the MCA do not get involved with boats abandoned on land.

4.1.2 What types of boats are abandoned?

Interviews and site investigations showed that the materials and lengths of abandoned boats varied (Tables 1 and 4), but as noted by the Harbour Master A – it does not matter what material the boat is made out of - they will all have to be paid to be disposed of. As records are not kept by the majority of interviewees there are no details of the ratio of wooden: FRP: metal boats found.

Site investigations proved valuable in assessing the various states boats are found in (Table 4). The state of a boat seemed to be a factor of time. Plate 1 shows boats 5 and 8 (Table 4); it demonstrates the decline in state of boat 5 when abandoned for 40 months. A visual inspection showed the deterioration of the hull with algae growing on it, paint flaking off and the concrete crumbling. This boat has no chance of being used again and no material value, compared to boat 8, which is in a good enough state to be sailed and possibly sold. It demonstrates the importance of finding the owner before the boat's state deteriorates beyond repair.

At marinas the problem evolves from boats being moved to hard standing by their owners for repairs (but still paying fees), to abandoning them and so they turn into wrecks. However Boatyard D and Shipyard A had several boats in poor condition, which, on first inspection, would have been classed as wrecks, but are actually paid to be left on hard standing. In one instance at Shipyard A, a boat had not been visited for six years but the fees were still paid. The owners were contacted and encouraged to visit but as the fees were being paid there is nothing that can be done to move the boat. The same was true for moorings on the River Itchen, even though the boats were in a bad state of repair as long as the mooring fees had been paid they are allowed to remain on the river. Conversely these boats are not abandoned but they are wrecks.

4.1.3 What problems are encountered?

Finding the owner The biggest problem for all concerned is tracing the owner of an abandoned vessel (Figure 1). As advised by the MCA registration of leisure vessels is not necessary within the UK – unless proof of ownership is required for application for a marine mortgage or for travel abroad with the boat (SSR), in which case the UK Shipping Register is used. Although there are Hull Identification Numbers and names on boats these are easily removed when intentionally abandoning a boat and even if not removed if the boat is not associated with a mooring, these details are not linked to contact details anywhere. This problem also arises when accidents occur and when boats are sold – one report describes a boat being sold in a pub whilst the owner was in jail.

Keeping track of boats In the time it takes to trace the owner the boat may be moved, painted or removed (Table 4), usually resulting in the whole process starting again. At site D several boats have been going through the process for up to two years or more.

Vandalism Notices for unpaid harbour dues placed on boats advertise it is unclaimed, this leads to theft of salvageable parts from the boat and it often being set alight. Although the burning of abandoned boats saves Harbour Masters and Local Authorities disposal costs, the resulting smoke may contain irritants and the resulting charred remains will contain glass fibres that are a hazard – both to humans and the environment. The burnt out hull will still have to be disposed of in the end. This was a particular problem at Site D.

4.1.4 How are the boats disposed of?

In all legislation considered (Figure 1) there is the chance to sell the boat on if possible. If the boat was in such a bad state that it could not be sold ultimate disposal methods of abandoned boats by all interviewees was to break the boat up. The boat is then deposited in a skip to be taken away by waste contractors to landfill.

Waste management companies advised that disposal of a boat would be more expensive than normal household waste due to its bulkiness, and advised they are rarely approached about this. The boat

would be taken to a transfer station and broken up, metal salvaged and recycled and the hull would be sent to landfill.

4.2 How to solve the problem

Table 5 details the responses from VT Halmatic. Each boat made (circa 50 a year) produces approximately 25% waste FRP material. The cheapness of raw materials puts no pressure on them to reuse or recycle the materials. There are no thoughts on stepping backwards and returning to use metals only – the boat making market is very competitive and FRP boats can always be bought from another country – this would just be moving the problem and companies would lose money.

Prof Shenoï thought there will be a move towards producer responsibility legislation, but that it is unlikely thermoplastics will be used extensively in boat building, as they are not as strong as thermosets; this will produce a need for more efficient recycling methods of thermoset FRP. Boat manufacture records are only kept for a short period of time and people that build boats in their own homes will not record the materials used, if a boat is to be recycled the specific material characteristics must be known so the correct technology can be used. Ultimately the lack of information on the materials will prevent the recycling of the boat, even if there is a stable market for the materials – which at the moment is the biggest barrier to recycling FRP.

4. Discussion

The lack of recorded information makes quantifying and identifying the problem of abandoned boats an impossible task. This causes a negative feedback loop of not knowing the information, not being able to assess the problem and not being able to provide solutions. It is clear, for example, that site D has a problem with abandoned boats; however the numbers of boats reported by other interviewees does not seem to be a significant but without records this is not qualified. Only records can prove if the numbers of abandoned boats do increase over the years. Disposal is flawed with taxpayers or private marinas bearing the cost of disposal.

Essentially these boats are being fly tipped which is an offence under section 33 (1) (c) of the EPA 1990 (Bell and McGillivray, 2006). Why should people be allowed to leave their waste anywhere they wish, and why is it acceptable for boats and not household waste to be fly tipped – because a service is provided for household waste disposal and not boats? The reasons for abandonment are not known, Smith *et al.*, (2004) suggest four reasons for the growth of abandoned vehicles; these are paralleled to boat abandonment (Table 6). Along with these reasons are two other ‘common sense’ possibilities; (a) that to dispose of a boat with full legal compliance is too expensive and (b) that the owner does not know how to dispose of it. There are no formal procedures currently in place for boat disposal in the UK.

Option b raises the issue of taking responsibility for ones waste – if someone really wanted to know how to dispose of a boat they could find out. Hansmann *et al.*, (2006) report that ‘social norms influence personal norms, consequently exerting an indirect influence on [recycling] behaviour’, if someone sees a boat discarded on a river bank or beach (e.g. site D) day after day, it could be believed this is an acceptable situation and thus follow suit. This situation may be used as justification of ‘deviant behaviour’ as part of Sykes and Matza’s (1957) neutralisation theory (see Hansmann *et al.*, 2006), i.e. the thought that justifications arise before the action takes place to make it acceptable. Others will repeat the behaviour and so the cycle continues. It would seem prudent to introduce an all-encompassing procedure for disposal of leisure boats that avoids the loopholes currently encountered. At present the only legislation that formally requires abandoned boats to be dealt with is the Merchant Shipping Act 1995 and this is only where it presents a shipping hazard. The tenders moved above the

high water mark at Site D should be disposed of by the Local Authority, but they are being left as they are no longer breaking any legislation and there are more pressing issues taxpayer's money should be spent on.

The main problem comes in identify owners of these boats (Figure 1). Harbour Masters in particular are in favour of registration of boats to solve this problem and decrease accidents. By introducing registration the 'polluter pays' principle can be applied and harbour dues and mooring fees can be more easily recovered. The feasibility study at site D showed as time progresses a boat's state will deteriorate and develop from being simply 'abandoned' to a wreck (Table 4). Only very new abandoned boats are worth trying to save as they do not require high repair costs and labour intensive work to rejuvenate them; there seems to be no middle ground between abandoned boats and wrecks. By contacting the owner the development of a boat to a wreck could be stopped and the boat sold before it becomes a wreck, thus reducing waste. Although Professor Shenoi pointed out registration would not capture all boat owners it is certainly a step in the right direction.

Registration is a contentious issue within the boating industry with thoughts that it may lead to licensing and increased costs that may put people off the pursuit. Registration also generates problems such as boundaries – how big should boats be to be registered and should jet skis be included? (personal communication MCA). Registration was thought unlikely to succeed by Marina owners due to the quick turnover of boats and casualness of some sales. However Marinas and public slipways provide ideal opportunities to 'catch' current owners of boats as a starting point for registration, who when they sell their boats will be more inclined to register the new owner or face the possibility of 'pollution' costs as discussed by Smith *et al.*, (2004) with regards to car registration. This will initially capture a large number of boat users. As well as owner details the age, make and model of the boat could all be recorded to enhance management in the future.

At the very least it is recommended that to fully assess the problem it should be made compulsory for Local Authorities, Harbour Masters and Marinas to record numbers and characteristics of abandoned boats they have to deal with, the results will indicate the direction that should be taken. Smith *et al.*, (2004) comment that numbers of abandoned cars can be indicated through the return of V28 forms by

Local Authorities, there is no such parallel for boats. Reporting back on numbers of ‘abandoned’ vehicles Local Authorities investigate within 24 hours of them being reported is already required (DEFRA, 2006), could this be extended to boats?

Before a disposal scheme can be implemented the potential recyclability/ recovery or reuse of the material should be investigated to steer the processes. Conroy *et al.*, (2005), Hedlund-Åström (2005), Marsh (2003) and Pickering (2005) all stated that currently 98% of composite waste is landfilled or incinerated. Whilst this is not yet true for the UK, Bell and McGillivray (2006) report that landfill tax is due to increase to £35/ tonne by 2011. If FRP producers ‘do not want to lose their market share to materials that are more easily recycled and reused’ Conroy *et al.*, (2005) and Marsh (2005) suggest they address the situation post haste. But as commented by VT Halmatic with no legislative imperative there is no onus to do this, especially as FRP is currently the most popular material for boat building. With competition from countries with cheaper labour, VT Halmatic say to stop using FRP would be to commercial suicide.

Reusing the hulls is possible in features such as ornamental flower beds and The Artificial Reef Subcommittees report that in Florida, in past years derelict fibreglass boats have been towed offshore, and sunk to create artificial reef. However due to inefficient sinking this practise is no longer allowed. Neither of these are a sustainable option for the future.

Hedlund-Åström (2005) commented that ‘as recycling thermoset polymers is so complicated it is important to acquire information about the constituents of the materials’, this was supported by Professor Sheno. For the material to be correctly identified the original manufacturer must be contacted but records are not kept for very long. This problem could be overcome by registering boats.

Figure 2 details ways in which glass reinforced fibre can be recycled. There are many applications for ground down FRP such as in cement and asphalt (Conroy *et al.*, 2005 and Pickering, 2006). Fine powder is also used as a filler substitute in boats, as practised by boat owners and VT Halmatic, although this is not sustainable, as there would be more ‘filler’ than is required. A key factor in recycling is the establishment of a stable market (Price, 2001). For it to be worthwhile developing

techniques to recycle the material there must be someone willing to buy it at a price that gives a profit, recycling is a business not a good will gesture. However recent reports of increased resin costs due to increased oil costs could be a driver to companies seeking cheaper alternatives (Reinforced Plastics Weekly, 2006).

Recovery techniques such as pyrolysis and fluid bed thermal processing (Pickering, 2005) are not economically viable as the raw materials are so cheap and the recovered fibres are not as strong. Recovery of energy by incineration is not practical either: Conroy *et al.*, (2005) state ‘the main business of incinerator operators is to dispose of municipal solid waste (MSW) and not produce energy; and by burning small volumes of FRP waste means larger volumes of MSW will be sent to landfill’.

It seems at present the only option for FRP from boats is disposal, until legislation forces research and development to look into the recycling of this material further or only use materials that can be recycled.

Finland has incorporated end of life boat breaking at it’s car recycling facilities (Anon, 2005). The metal is recovered for reuse as a raw material and it is reported the plastic is used to gain energy. The glass fibres are used as fillers. Learning from Finland, we could potentially use car recycling centres set up for implementation of the ELVD to break down boats. Although if there is little value in the material this seems unneeded as current practises already recover metal before the hull is sent to landfill, so waste transfer stations seem to be the most practical option. Conversely if markets change and ground up FRP does become an economically viable product then use of car recycling facilities may be a good way forward as there will be no need to build additional processing centres.

Forslind (2005) reports the main provisions of the ELVD include the free take back of vehicles for disposal with all costs being incurred by the producer of the car. This approach would be an effective measure in decreasing abandoned boats; however there is also a need to reduce the time and effort spent by the owner in disposing of the boat. By making it the producer’s responsibility to cover the costs of collection of the boat all obligations are diverted from the owner, but this does not make people responsible for their waste. In Sweden a ‘Car Scrapping Fund’ is set up by the initial buyer of

the car and recovered in each sale as part of the cost of the car (Forslind, 2005), with the ELVD the producer pays for the scrapping and the fund is reimbursed by the scrapping facility on delivery of the car by the owner. A similar deposit - refund scheme could encourage boats to be taken for disposal. Second hand boats are sold on very cheaply nowadays; a 'tack back' tax on the price of the boat would probably be more money than the boat and so would discourage sales which in turn could encourage the seller to take the boat back instead of dumping it. As Kulshreshtha and Sarangi (2001) pointed out 'Deposit-refund systems impose a cost on the consumer only when the product is discarded'.

5 Conclusion

This study shows the lack of recorded information has resulted in an unquantifiable problem of abandoned end of life boat hulls in the sites studied. The insufficient waste legislation to treat the problem has been highlighted and the attitudes of people dealing with it seem to be a result of the legislation not direction towards solving a long term waste problem.

It seems that effective recycling of FRP is a long way off so a disposal process should be developed to discourage fly tipping. A deposit – refund scheme could encourage proper disposal of boats with a financial reward at the end. In keeping with other producer responsibility legislation, it is right that producers of boats should endure the cost of the waste management. This cost will undoubtedly be reclaimed through higher boat prices, as discussed by Forslind (2005) for cars, however the boating market is very affluent and costs would probably be absorbed. The scheme that is implemented must be effectively advertised to interested parties (e.g. through boating clubs and marinas) and registration would give a ready made database of boat owners.

In the UK we frown upon fly tipping, impose a duty of care and grant waste management licenses to ensure waste is dealt with responsibly. We survey areas of land common to fly tipping and trace waste back to owners to impose fines, yet turn a blind eye to boats dumped on public land. It seems almost accepted that marinas and riverbanks will have abandoned boats, is this accepted because it has become normal? There are ways of disposing of abandoned boats so why are people not fined for neglecting these? It seems contradictory that fines are imposed for abandoned cars and other waste and not boats; in fact it almost seems unfair.

Acknowledgments

I would like to thank the RYA and the Southampton Environment Centre for the initial introduction to the project, and the RYA for their financial support. Many thanks go out to all interviewees who made the research possible. Many thanks to Dr. Pete Shaw for the long meetings and sound advice.

References

Anon, 2005. Cars and boats recycled.

<http://www.finnfacts.com/english/main/actualities/kuusakoski.html> [accessed 15th May 2006].

Artificial Reef Subcommittees of the Atlantic and Gulf States Marine Fisheries Commissions, 2004. Guidelines for Marine Artificial Reef Materials 2nd ed. <http://www.gsmfc.org/> [accessed 15th May 2006].

Bell, S. and McGillivray, S., 2006. Environmental Law 6th ed. Oxford University Press, Hampshire.

British Marine Federation, Environment Agency and Royal Yachting Association, 2006. Environmental Code of Practise; Practical advice for businesses, sailing clubs and training centres.

British Marine Federation, 2006. Statistics and Market Research. <http://www.britishmarine.co.uk/> [accessed 31st September 2006].

Conroy, A., Halliwell, S. and Reynolds, T., 2005. Composite recycling in the construction industry. Compos. Part A – Appl. S., 37 (8): 1216 – 122.

Department of Environment, Farming and Rural Affairs, 2006. What happens to waste? <http://www.defra.gov.uk/environment/waste/topics/index.htm> [accessed 2nd September 2006].

Department of Environment, Farming and Rural Affairs, 2006. Guidance on Nuisance Parking and Abandoned Vehicle Legislation. <http://www.defra.gov.uk/environment/localenv/legislation/cnea/vehicles.pdf> [accessed 30th August 2006].

Department of Environment, Farming and Rural Affairs, 2006. Overview of the ship recycling process in the UK – Draft Guidance.

<http://www.defra.gov.uk/corporate/consult/shiprecycling-strategy/index.htm> [accessed 25th May 2006].

Department of Environment, Transport and the Regions, 1999. Environmental Protection Act 1990: Code of Practice on Litter and Refuse.

du Plessis, H., 2002. Fibreglass Boats 3rd ed. Adlard Coles Ltd, Great Britain.

E-Composites, 2005. Global Recreational Boating Industry Analysis and Forecast 2005 – 2010. <http://www.e-composites.com/MarketMarine.htm> [accessed 30th May 2006].

Flowerdew, R and Martin, D., 1997. Methods in Human Geography – A guide for students doing a research project. Pearson Education Limited, England.

Forslind, K., 2005. Implementing extended producer responsibility: the case of Sweden's car scrapping scheme. J. Cleaner Prod., 13: 619 – 629.

Hansmann, R., Bernasconi, P., Smieszek, T., Loukopoulos, P., Scholz, R.W., 2006. Justifications and self – organisation as determinants of recycling behaviour: The case of used batteries. Resour. Conserv. Recy., 47: 133 - 159.

Hedlund-Åström, A., 2005. *Model for End of Life Treatment of Polymer Composite Material* - Doctoral Thesis (Ph D), Royal Institute of Technology in Stockholm.

Karagiannidis, A., Xirogiannopoulou, A. and Moussiopoulos, N., 2006. On the effect of demographic characteristics on the formulation of solid waste charging policy. Waste Manag. 26: 110 – 122.

Kulshreshtha, P. and Sarangi, S., 2001. 'No return, no refund': an analysis of deposit – refund systems. J. Econ. Behav. Organ., 46 (4): 379 – 394.

Maritime and Coastguard Agency, 2006. *UK Shipping Register*.

http://www.mcga.gov.uk/c4mca/mcga-the_mca/mcga-uk_registration.htm [accessed 7th May 2006].

Marsh, G., 2005. Recycling collaborative combats legislation threat. *Reinf. Plast.*, 49(8): 24 – 28.

Marsh, G., 2003. Europe gets tough on end of life composites. *Reinf. Plast.*, 47 (8): 34 – 39.

Marsh, G., 2001. Facing up to the recycling challenge. *Reinf. Plast.*, 45 (6): 22 – 26.

New Forest District Council. Recreation and Tourism. www.nfdc.gov.uk/coastal/cmp/CMPPartB8.pdf

[accessed 13 September 2006].

Office of Public Sector Information. Merchant Shipping Act 1995.

http://www.opsi.gov.uk/acts/acts1995/Ukpga_19950021_en_1.htm [accessed 10th May 2006].

Parkyn, B., 1970. *Glass Reinforced Plastics*. Butterworth and Co. Ltd, London.

Pickering, S.J., 2006. Recycling technologies for thermoset composite materials – current status.

Compos. Part A – Appl. S., 37: 1206 – 1215.

Price, J.L., 2001. The landfill directive and the challenge ahead: demands and pressures in the UK

householder. *Resour Conserv Recy.*, 32: 333 – 348.

Reinforced Plastics Weekly, 2006. Issue 161.

Royal Yachting Association, 2006. *Abandoned Boats*.

<http://www.rya.org.uk/WorkingWithUs/clubs/premises/abandonedboats.htm> [accessed 12th April

2006].

Scott, R.J., 1996. Fiberglass Boat Design and Construction 2nd ed. The Society of Naval Architects and Marine Engineers, New Jersey.

Smith, M., Jacobson, J. and Webb, B., 2004. Abandoned vehicles in England: Impact of the End of Life Directive and new initiatives, on Likely Future Trends. Resour Conserv Recy., 41: 177-189.

Tables

Table 1: Responses to standard questions

Interviewee	How often do you deal with abandoned boats?	Types of boats
Harbour Master A	8 a year – very crude estimate	Various
Harbour Master B	Not many	Tenders
Harbour Master C	100 wrecks in 4 years	Tenders on slipway, assorted at Site D – wooden and fibreglass
Borough Council A	Not very often	Not recorded as so seldom occurs
Parish Council A	Not very often	Generally wooden at end of life
Shipyard A	14 untraceable in 2005, 1 in 2006 (so far)	Wooden and fibreglass
Boatyard B	Monitor and prevent – 1- 2 a year	Wooden and fibreglass
Boatyard C	Monitor and prevent – so not many	Wooden and fibreglass
Boatyard D	Monitor and prevent – not many	Wooden and fibreglass

Table 2: Attitudes and actions of marinas towards abandoned boats

Prevention	Treatment
Moorings are closely monitored to establish the state of boats.	As advised by the Royal Yachting Association the Torts (Interference with goods) Act 1977 is used. ^a
Owners of boats in poor states are contacted through contract contact details.	
Owners advised to remove boat from water to perform maintenance work – ‘hard standings’ are available to rent for this.	

^a: Legislation detailed in figure 4

Table 3: Numbers of abandoned boats observed at site D

Boat Type	Above Highwater Mark	Below Highwater Mark
Tender	31	1
Boat	15	15
Houseboat	5	0

Table 4: Examples of abandoned boats at site D

Boat Number	Length (metres)	Material	Residency Time (months)	State
1	45	Timber	8	Wreck
2	11	Timber	12	Wreck
3	3	FRP	Below 3 months ^a	Abandoned
4	7	FRP	Below 3 months? ^b	Abandoned
5	9	Concrete & FRP	40	Wreck
6	8	FRP	Below 3 months ^a	Abandoned

^a: Infrequent surveys of site make finding exact residency times difficult

^b: Boats being moved and painted adds to difficulty of identifying boats and their residency time

Table 5: Responses from interview with VT Halmatic

Question	Response
How much FRP waste do you currently produce?	50 tonnes a year.
How is the waste dealt with?	Put into non hazardous waste skips and sent to landfill via waste contractor.
Do you operate an exchange service when people buy new boats?	Yes, some MOD boats are serviced and sent back for less demanding tasks.
How do you think Producer Responsibility affect the boat building industry?	Will cost money, but will improve customer relations and marketing.
How can you make boats more recyclable?	Use materials that are more recyclable, move towards thermoplastic FRP for more designs where specifications will allow.
What options have you investigated for recycling/ reuse of FRP?	Grinding up resin and using as filler occasionally. Thermoplastic boats are taken back and re heated to give new life to boats.

Table 6: Paralleling vehicle abandonment with boat abandonment (adapted from Smith *et al.*, 2004)

Reason for abandoned vehicle	Paralleled by boats?	Reason
Decrease in scrap metal prices	No	It is not currently cost effective to recycle hull materials.
Weakness in vehicle licensing and registration system	Yes	No registration system in place for boats so it is impossible to trace boat owners.
Growth in pool of cheap vehicles	Possibly	Boats may be sold very cheaply to avoid expensive disposal costs, which would stop abandonment, but a boat that can not be sold may be abandoned. Conversely the buyers of boats may be abandoning their current boat.
Increasing running costs and vehicle technology	Yes	Increasing insurance and repair costs make disposal more cost effective.

Figures

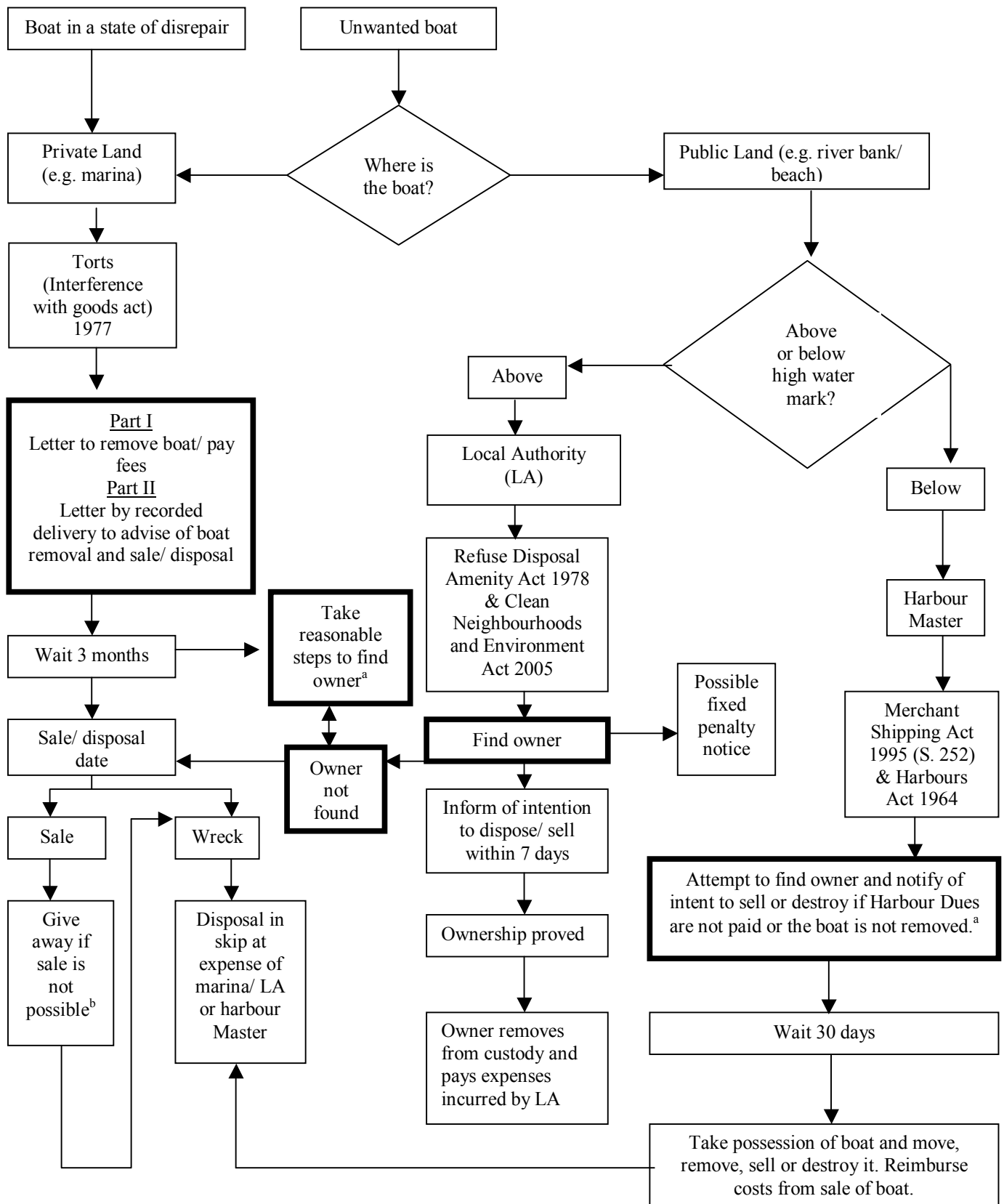


Fig. 1: Legislation routes to treat abandoned boats - bold boxes indicate areas of difficulty

^a: Notices in newspapers and on the boat

^b: To charities and educational institutes such as: The Jubilee Sailing Trust, Sea Scouts, local ship building college or MOD.

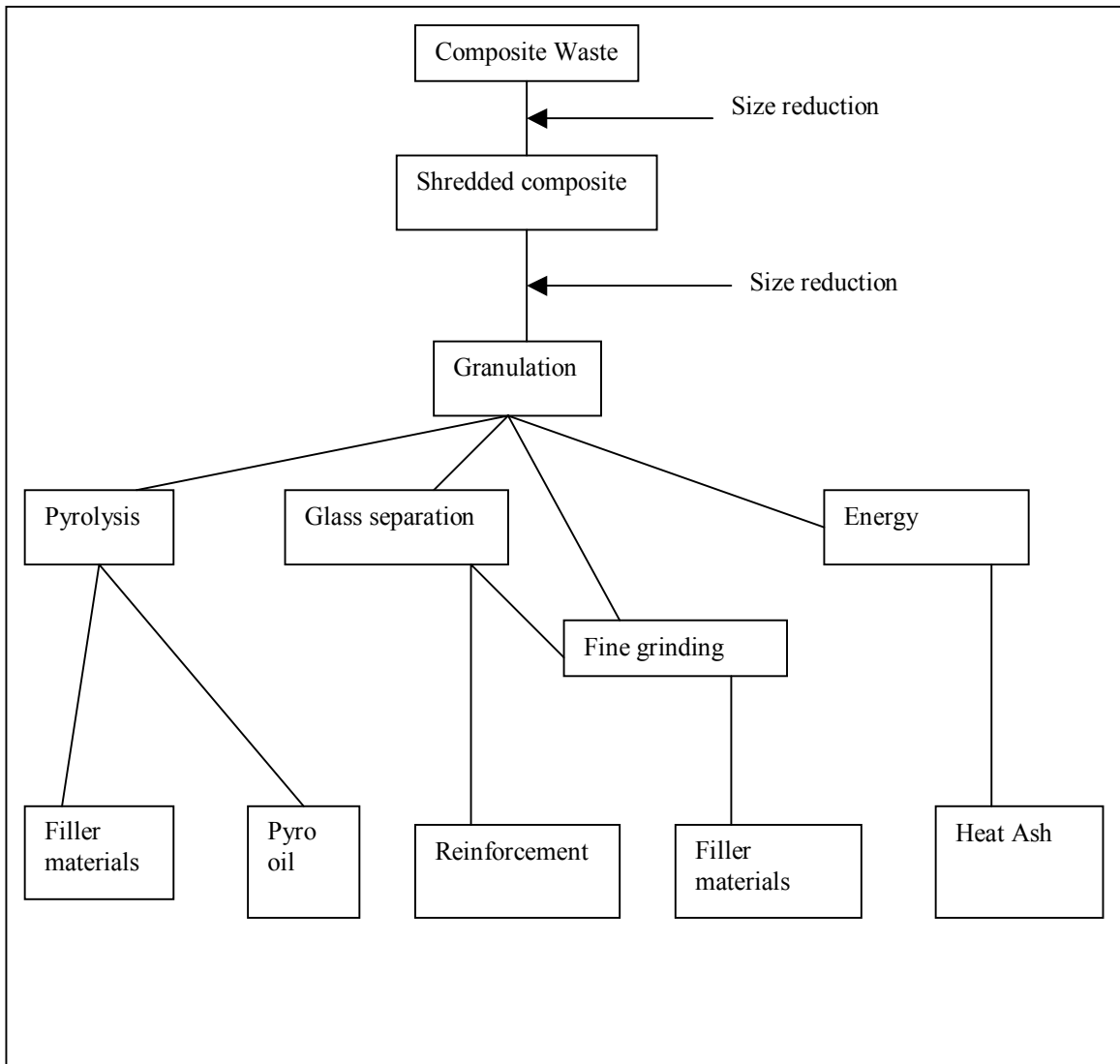


Fig. 2: Recycling options for glass reinforced plastic (adapted from Marsh, 2001)



Plate 1: Comparison of two boats found at Site D. Top: Boat 5 abandoned for 40 months. Bottom: Boat 8 new to the beach.