Report

Burning behaviour of recycled doorstep refuse

Westminster City Council & London Borough of Hackney

25 January 2008

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For the benefit of business and people

Report

Burning behaviour of recycled doorstep refuse

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1 Introduction

This report refers to the request for fire risk assessments in residential housing estate blocks arising from doorstep recycling. The principal objective of the project was understood to be to inform the sponsoring local authorities about the most appropriate means of providing convenient recycling services to high rise properties. The Purchase Order ECC/OS/5115 from city of Westminster refers.

2 Background

A letter from London Fire Brigade (LFB) dated 6 July 2007 was received by Westminster City Council (and others) in August 2007 about potential fire risks from dry recyclable refuse by doorsteps in high rise properties. Regular doorstep collections are made by various means including disposable plastic sacks, reusable 30 l plastic 'tote' bags and reusable rigid boxes. The recyclable materials include some or all of the following: -

- Paper, including newspapers;
- Cardboard;
- Glass jars and bottles;
- Tin cans and aluminium cans; and
- Plastic bottles such as polyethylene/polypropylene or polyester.

It is understood that a typical arrangement is for residents to present their recyclable waste from 8 am ready for collection between 8 & 11 am one day each week. Reusable bags, where used, are posted through letter boxes or left near front doors ready for use next week. Under this arrangement the notional duration of 'exposure' to risk of ignition in a common area is 3 hours out of 168 hours, namely 1.8% of the time.

Following the LFB letter, a comprehensive fire risk assessment of the estate doorstep collection activity was sought. As a result, we have carried out spot checks at a sample of properties by visiting those listed in a schedule provided where doorstep recycling is in place. A general assessment of the impact of the recycling on fire safety has been carried out; recyclable waste has been visually assessed for generic types of materials; some genuine recycling waste has been more closely examined; and ignitability and burning tests have been carried out on representative waste provided. This report contains summarised information about the waste found at estates; information about actual waste; and results of ignitability and burning tests.

The Regulatory Reform (Fire Safety) Order 2005 applies to all residential property with common parts, including certain houses in multiple occupation (HMOs) licensed by local authorities under the Housing Act 2004. Landlords of residential property that has common parts have a duty to carry out a fire risk assessment because the common parts can be workplaces for employees or contractors and to protect residents and visitors. They will have a duty to identify and provide appropriate and accessible safety measures. Any facilities provided for the use and protection of

fire-fighters need to be maintained by the landlord. This project does not purport to provide a full fire risk assessment that meets the above Order but includes aspects that would be included in such an assessment.

3 References

Information supplied included: -

- Westminster / Hackney Schedule of requirements
- Schedule of properties on Estates
- Dear Chief Officer letter from LFB dated 6 July 2007;

4 Procedure

Estates on the schedule provided were visited, concentrating wherever possible on the time and day of regular waste collection. At each premises details were noted and recorded about the following: -

- General arrangement of the building, including photograph, in terms of fire safety (geometry, structural fire resistance & separation, combustible materials and linings, and housekeeping);
- Details of recycling arrangements (container, location, contents).

Seventeen containers of real recyclable waste were provided by Westminster City Council and L B Hackney. All samples were submitted by the client: Bureau Veritas was not involved in sample selection. Types of container included: -

- Hackney green reuse 'tote' bags (all filled – see photo 1);
- Hackney green reuse food boxes (all filled – see photo 2);
- Westminster black basket (filled and empty – see photo 3);
- Westminster blue reuse 'tote' bags (all empty – see photo 4);
- Westminster disposable blue plastic sack (all filled – see photos 5 & 6).

Some photographs taken at the sites visited, of the waste delivered to us, of the containers and of the fire tests are included for information (e.g. see photos 7 & 8).

Ignitability / fire tests were carried out on each type of container and several filled containers for demonstration purposes, some of which were observed by staff from Westminster and Hackney. Tests were made as realistic as possible by deliberately igniting the outer container using a hand-held simulated match / cigarette lighter.

Matches or other sources dropped to simulate accidental ignition were omitted as our research has shown the chance of fire development to be small and unpredictable.

Likewise, no tests were carried out using smouldering ignition sources as the final containers, like other synthetic thermoplastic materials, have not been found to be susceptible to ignition by a smouldering cigarette source. However, it is recognised that where cellulosic materials such as paper are present and accessible, smouldering ignition could occur and eventually lead to a flaming fire. Because the development of such a fire is strongly dependent on many conditions such as the nature and form of the cellulosic material, location and orientation of the smouldering source, heat loss / gain characteristics and the presence of other materials, the time for flaming to develop is likely to be very uncertain. Indeed, there is no certainty that a flaming fire would develop at all or if so that it could be over a protracted time scale. Such fire tests were therefore omitted both for expediency and because of the relatively lower probability of a fully developed fire.

During each test, observations were made of ease of ignition, fire growth characteristics – including molten flaming material, mass loss and final observations.

Some photographs are appended for information.

5 Results

Table 1– summary of waste samples provided

No.	Lab ID no.	Description	mass (g)	Combustibles		Non-combustibles		NOTES
				%	g	%		
		LB Hackney						
1	HB	empty green bag	212	100.0	212	0.0		
2	HB1	full green bag	4725	92.2	4355	7.8	370	Paper
3	HB2	full green bag	6726	85.3	5743	14.6	983	"
4	HB3	full green bag	8885	100.0	8885	0.0	0	"
5	HB4	full green bag	6631	98.1	6507	1.8	124	"
		Total weight	26967		25490		1477	
		Average weight	6742		6373		369	
		Average %		95.0		5.0		
6	HF1	full green food box	8515	N/A	502	N/A	8013	Water
7	HF2	empty food box	502	100.0	502	0.0	0	Empty
		City of Westminster						
8	WB1	full black basket	10550	84.8	8956	15.2	1594	Mixture
9	WB2	empty black basket	960	100.0	960	0.0	0	Empty
10	WBB1	empty blue bag	171	100.0	171	0.0	0	Empty
11	WBS	empty blue sack	29	100.0	29	0.0	0	
12	WBS1	full blue sack	2558	75.3	1926	24.7	632	Paper
13	WBS2	full blue sack	4211	95.7	4030	4.3	181	"
14	WBS3	full blue sack	8723	61.2	5340	38.8	3383	"
15	WBS4	full blue sack	1115	91.1	1016	8.9	99	Plastic bottles
16	WBS5	full blue sack	10097	100.0	10097	0.0	0	Paper
17	WBS6	full blue sack	5210	49.6	2587	50.4	2623	"
18	WBS7	full blue sack	7210	71.7	5170	28.3	2040	"
19	WBS8	full blue sack	2243	69.3	1554	30.7	689	Aerosol, plastic, tin
20	WBS9	full blue sack	5233	100.0	5233	0.0	0	paper
21	WBS10	full blue sack	5870	23.2	1359	76.8	4511	Glass bottles
22	WBS11	full blue sack	2698	65.6	1771	34.4	927	Paper mix
		Total weight	55168		40083		15085	
		Average weight	5015		3644		1371	
		Average %		73		27		

Key: High combustible content Low combustible content

For the custom tests in this project, the simulated match flame was initially applied for about 15 s in each case. For simplicity, tests involving uncontained primary sources of fuel, e.g., storage, household or personal items other than recyclable containers were omitted.

The results of the tests using the method above are summarised in the Table 2. These test results were obtained using the specified test conditions and do not necessarily represent the behaviour of the samples under other conditions of test or use. We understand that the samples supplied were representative, but owing to individual variations and the wide range of personal response by householders, it may not have been possible to identify all potential problems.

Table 2 –summary of ignitability and fire tests

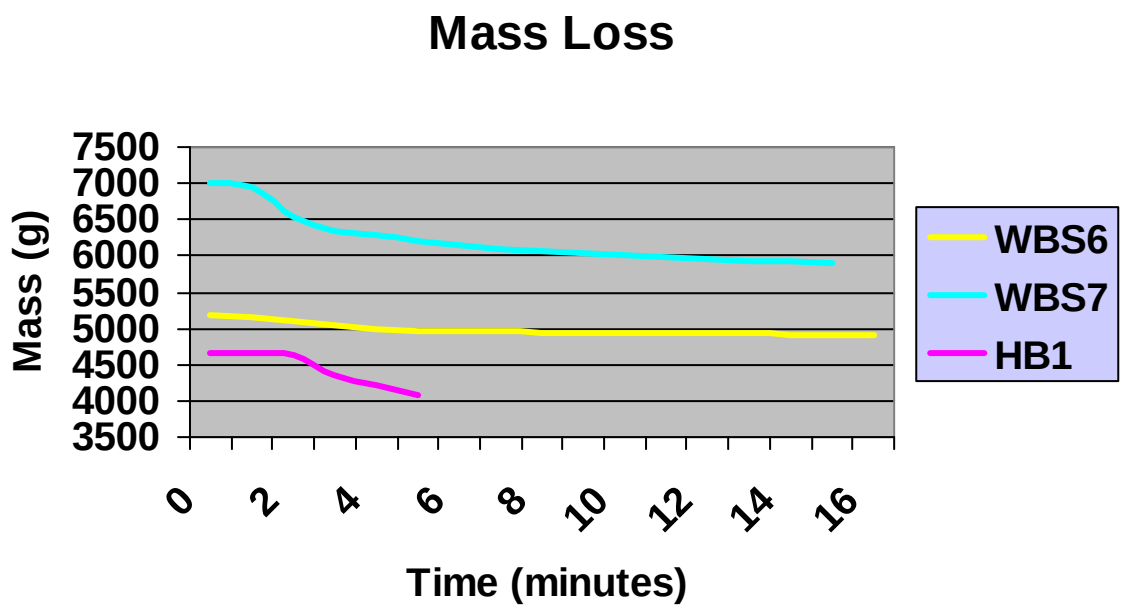
No.	Lab ID no.	Description	NOTES
		LB Hackney	
1	HB	empty green bag	212 g polyethylene/polypropylene, no resistance to ignition
2	HB1	full green bag	92.2% combustibles, mainly paper, see HB1 on chart
3	HB2	full green bag	
4	HB3	full green bag	
5	HB4	full green bag	
6	HF1	full green food box	Wet food waste
7	HF2	empty food box	502 g polyethylene/polypropylene, no resistance to ignition
		City of Westminster	
8	WB1	full black basket	
9	WB2	empty black basket	960 g polyethylene/polypropylene, no resistance to ignition
10	WBB1	empty blue bag	171 g polyethylene/polypropylene, no resistance to ignition
11	WBS	empty blue sack	29 g polyethylene/polypropylene, no resistance to ignition
12	WBS1	full blue sack	
13	WBS2	full blue sack	
14	WBS3	full blue sack	
15	WBS4	full blue sack	
16	WBS5	full blue sack	
17	WBS6	full blue sack	50% combustibles, mainly paper, see WBS6 on chart
18	WBS7	full blue sack	71.7% combustibles, mainly paper, see WBS7 on chart
19	WBS8	full blue sack	
20	WBS9	full blue sack	
21	WBS10	full blue sack	
22	WBS11	full blue sack	

This table shows that the recycling containers can contribute a significant amount of combustible material to the overall 'fire load' of recycled waste. For example, the Westminster reusable black rigid plastics basket (WB2) weighs 960 g – more than consumed in some tests on other containers (see chart below). In order of reducing mass, the containers were thus: -

- Westminster reusable black rigid plastic basket (WB2) 960 g;
- Hackney reusable green rigid plastic kitchen waste box (HF2) 502 g;
- Hackney reusable green fold-flat plastic bag (HB) 212 g;
- Westminster reusable blue fold-flat plastic bag (WBB1) 171 g; and
- Westminster disposable blue plastic sack (WBS) 29 g.

It is thus evident that the disposable plastic sack provides the smallest contribution to overall fire load. A significant disadvantage of the heavier amounts of plastics, as in the case of the other four types of container, is the tendency to melt and flow when heated forming a molten pool that burns for a long time, produces a large amount of heat and transfers heat to other combustible materials.

Chart 1 – Typical mass loss against time



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Sample WBS6 (see photo 5) comprised about 49 % paper, etc, and 51 % glass or other non-combustibles by weight. The paper was largely in the form of a stack of folded newspapers and magazines. The original mass was 5210 g of which some 280 g was consumed over the 16 minute duration of the fire. In the first few minutes the polythene sack was either consumed or formed a melt pool on the outside of the contents. After about the first 9 minutes the residual fire comprised several small isolated peripheral fires mainly centred on melted polythene from the sack. Flaming virtually ceased after 16 minutes and the test was then stopped. Only about 5.4 % of the total was consumed (11.2 % of the combustibles) because the core bulk comprised folded close-packed newspaper that burned only at the perimeter.

Sample WBS7 (see photo 6) comprised about 71 % paper, plastics, etc, and 29 % glass, tins or other non-combustibles by weight. The paper was again largely in the form of a stack of folded newspapers. The original mass was 7210 g of which some 1100 g was consumed over the 16 minute duration of the fire. In the first few minutes the polythene sack was either consumed or formed small melt pools on the outside of the contents. After about 10 minutes the fire was dying down and comprised several small isolated peripheral fires mainly centred on melted polythene from the sack. Flaming virtually ceased after 16 minutes and the test was stopped. About 15.7 % of the total was consumed (22 % of the combustibles) because the core bulk comprised folded close-packed newspaper that burned only at the perimeter.

Sample HB1 comprised about 92 % paper, etc and only 8 % tins or other non-combustibles by weight. The paper was largely in the form of a stack of folded newspapers and magazines but also included combustible boxes and packaging, thus increasing the openness within the fuel. The original mass was 4725 g of which some 580 g was consumed over the 5¾ minute duration

of the fire: the fire was terminated early due to excessive heat release causing temporary failure of the smoke extract system. In the first few minutes the Hackney reusable green fold-flat plastic bag was either consumed or formed a significant melt pool on the outside of the contents. After about the first 2 minutes the bag allowed the contents to spill out and by 2½ minutes a significant fire had developed and spread beyond the original bag area. Up to 5¾ minutes there was a reasonably steady state (peak output) fire that continued to involve the melted polythene bag. The consumed materials represented some 12.4 % of the total (13.5 % of the combustibles).

6 Summary of tests

6.1 Containers

All the containers were made of combustible, thermoplastic polymeric materials either in the form of disposable sacks, reusable fold-flat bags or rigid boxes. None had any inherent flame-resistant additives and consequently none had any resistance to ignition by a small flame source representing smoker's materials such as a match or cigarette lighter. However, in this respect the black plastic basket from Westminster took marginally longer to ignite because of its relatively thicker cross-section, but also provided the largest amount of combustible material and fuel load. The disposable plastic sack provided the least combustible mass and thus made the least contribution to overall fire load.

Because all the containers were made of thermoplastic polymers there was a characteristic tendency for the material to soften and melt when heated, thus leading to a flaming molten pool fire. The significance of the impact of the pool fire was proportional to the amount of container material available and on the amount as well as the type of combustible waste contained.

All sample containers were resistant to ignition by smoker's materials such as a smouldering cigarette.

6.2 Waste

As expected, recyclable waste comprised both combustible and non-combustible household materials. Folded solid stacked newspapers and magazines have been shown to be remarkably resistant to rapid burning. Most times a core of unburned material remains or is at least very slow to burn. Empty plastic milk bottles and like containers on the other hand are hollow, thermoplastic materials and, like some recycling containers, lead to rapid and intense burning, molten flaming pool fires and significant flame spread beyond the original area.

Complete consumption by fire of the recycling waste did not occur. Not only was there a 'non-combustible' content including glass, tins and cans, but even the combustible materials stopped burning after a time. Thus the consumed material comprised some 5.4% - 15.7% of the total mass (11.2% - 22% of the combustible content).

6.3 Locations

Photos 7 & 8 show typical waste recycling in situ and ready for collection from doorsteps. In the first case, the waste is on an open access or deck access balcony. The flat front doors may be designed to have some degree of fire resistance in case of a fire within the flat. However, as in the photo, there are often adjacent windows of ordinary glass typically to rooms such as kitchen or bathroom accommodation. A fire within the flat could therefore be expected to cause damage to and to exit from such a window on to the open balcony. Generally, residents in an unaffected flat are assumed to be advised to remain in their flat until told otherwise by emergency services. The solid front doors and height of windows mean that it should be possible to 'crawl' past a flat on fire, at least in the early stages, if necessary.

Waste by a doorstep on an open access balcony may therefore bee regarded as a significantly lower hazard than a fire within a flat. This is because we have shown the fire to be likely to have a reasonably slow controlled rate of heat release (17.5 g/min to 100 g/min – i.e. up to 0.002 kg/s), to be reasonably confined in location, and to be easier to put out than fully developed fires contained in a room or at higher level, or to stop burning after about a quarter of an hour. However, a doorstep waste fire on an open access balcony could smoke log the flat or ignite curtains within and lead to a fire in the flat.

Photo 8 shows the alternative case of waste at doorsteps in a fully enclosed lobby landing. These areas are typically designed to be free of combustible materials; to rely on fire resistance of a flat front door to contain a flat fire; to have no perforations, e.g. windows (other than fire-rated front doors) between the flat and landing; and for the lobby landing to be reasonably free of smoke / heat / combustion products for purposes of escape and fire fighting. The extent to which this design philosophy might be prejudiced depends on all these factors being maintained. Waste recycling can only be seen as in opposition to these design objectives, albeit for a relatively short duration – see 6.4, below.

6.4 Occasion

From information provided, it is noted that waste collection is typically scheduled over a 3 hour period, say 8 am to 11 am, one day a week, which is 1.8 % of the total time. The risk of ignition is loosely dependent on this minimal time of exposure but may also be skewed by factors such as regularity, frequency and opportunity that engender an element of pre-planning.

7 Summary of estate surveys

7.1 Survey Results

Photographs of types of recycling container provided as part of this project are appended, together with typical filled disposable sacks and reusable bags in situ.

The schedule of estate properties in Westminster is given in Appendix B1 followed by the individual assessments in alphabetical order of estate, and finally a summary table for all these premises. Hackney premises follow a similar pattern in Appendix B2.

7.2 Assessments

Each premises on the two schedules was assessed for general fire safety features in the accessible communal parts. Our usual fire risk assessment approach was modified and truncated to concentrate on the waste recycling objectives. Accordingly, 'premises factors' were summarised for structural fire safety features and for 'housekeeping' aspects such as accessibility, storage and vandalism.

Recycling details were noted for reference, especially the type of container provided for the waste. The waste found outside a selection of doorsteps was examined more closely so that a visual estimate could be made of the general ratios of paper & card; plastic; tin cans; glass; food and other materials for comparative purposes.

7.3 Recommended actions

As a result of the assessments, the fire safety of doorstep waste recycling at each premises has been rated as low, medium or high risk. Once the risk has been established, steps can be considered to reduce the risk, according to its severity and potential impact. As with most risks, the policy, in order of preference, should be to: -

- Eliminate the risk;
- Reduce the risk;
- Control the risk; or
- Manage the risk.

In this case elimination is the last resort because it means no door step waste recycling: in cases of high fire risk, this could be the only option. However, steps to be considered are listed in two tables of examples of 1) measures for high risk premises, 2) measures for lower risk premises, and a combination of both some medium risk premises. These examples can be viewed in section 8.3 below.

8 Compliance

8.1 Regulatory Reform (Fire Safety) Order

As noted in section 2, landlords of residential property that has common parts have a duty to carry out a fire risk assessment because the common parts can be workplaces for employees or contractors and to protect residents and visitors. They will have a duty to identify and provide appropriate and accessible safety measures. Any facility provided for the use and protection of fire-fighters needs to be maintained by the landlord. This project did not purport to provide a full fire risk assessment that meets the above Order but included aspects that would be included in such an assessment.

The presence of waste recycling at doorsteps of flats is therefore one factor that needs to be taken into account in a general fire risk assessment. Our assessments regarding mainly the waste recycling aspects are appended for each property / estate visited.

8.2 Dear Chief Officer Letter

In the above-mentioned letter reference has been made, *inter alia*, to risk assessments already carried out. The quotation, concurred by LFB, is that: -

> 'the scheme (doorstep collection) in its present form is unacceptable in properties that rely on single internal staircases, internal corridors or escape in one direction only, as part of the means of escape'

Our assessments and research also tend to concur with this statement, other things being equal, as a generalisation. However, a full individual and premises-specific fire risk assessment as mentioned in section 8.1 would be seen as overriding this generalisation. The LFB recommendation that (the presence of flammable materials) 'is taken into account in the Council's fire risk assessments' is therefore endorsed in the first instance – see appended fire risk assessments.

8.3 Positive measures

In order to minimise the potential impact of waste recycling in case of fire, the following measures are considered as positive measures: -

a) Minimise the fire load;
b) Minimise the time of exposure;
c) Minimise access by the public to common parts, stairs, corridors and lobbies;
d) Consider the provision of fire detection and warning systems and / or fire suppression systems;
e) Consider ventilation and zoning for smoke extraction systems to limit smoke spread;

f) Consider the provision of relevant initial fire-fighting equipment;
g) Enhance facilities and systems for fire-fighters;
h) Ensure full compliance of designed fire safety measures (including any of the above) such as compartmentation, fire doors, flat front doors, ducts, partitions, and surface finishes (multi-layer paints) to walls, ceilings and soffits.

Consideration of the above principles leads to the view that a risk-based approach is being recommended for which generalisations are not necessarily the most appropriate. However, in respect of factor a), the fire load added as a result of waste recycling is considered the principal factor to be assessed for each location on an individual basis. Subject to this proviso, the impact on fire safety in most blocks of flats will be variable. This is because of variations in features such as a) to h) as well as location of the relevant doorstep, housekeeping, vandalism, etc.

To assist compliance with the LFB guidance quoted in 8.2 above the following list (list 1) gives examples of alternative measures that should be considered to improve fire safety: -

List 1 Examples of measures to consider where premises are high risk for doorstep recycling

Alternative measures
Use central recycling point (s) – away from entrances / exits / windows
Use room separated from common parts e.g. chute room or ex-drying room
Use existing refuse chute only for recycled waste at specific times / days
Install a new chute specifically for all recycled waste
Install non-combustible bins near each doorstep e.g. metal bins with flip lid and disposable poly bag (possibility of internal fire extinguishing media)
Collect only non-combustible waste (glass, tins & drinks cans)
Collect recycled waste only by appointment e.g. for disabled / mobility impaired residents.

Where doorstep recycling may be considered low risk and therefore reasonably acceptable some measures that could improve fire safety are listed below (list 2).

List 2 Examples of measures to minimise fire risk from recycled waste

Additional measures
Use only thin-wall disposable waste sacks to minimise fire load
Compress / crush plastic bottles, tins, drinks cans, cardboard cartons to minimise voids and reduce burn rate
Collect only non-combustible waste (glass, tins & drinks cans)
Limit the amount of combustible recycling materials – no overspill bags or boxes.
Locate recycled waste away from windows / doors / vents / service or access doors
Locate recycled waste in widest part of escape route
Introduce / improve security to each flat / corridor / staircase / entrance by door access control / key locks / concierge / CCTV
Introduce fire separation in corridors / staircases e.g. fire doors
Ensure existing fire doors are undamaged & effective, self closing and have smoke seals
Install automatic fire detection
Install automatic smoke extraction system(s) linked to detection – mechanical or natural
Install fire fighting equipment / supply fire extinguisher to each flat
Install sprinkler system
Discontinue doorstep collections where residents habitually store combustible materials
Supply reusable non-combustible or flame-retarded collection bags

Where doorstep recycling has been rated as medium risk (borderline) measures from both list 1 and / or list 2 could be considered to improve fire safety, depending on the existing features.

9 Conclusions

Recycled doorstep waste, other than food waste, has been found to contain up to 100 % combustible material including paper and plastics, and tends to be in thermoplastic containers – whether disposable or reusable – that add to the amount of combustibles present. However, most waste contained some non-combustible content that added to the mass but not to the potential fire severity.

Custom fire tests have been carried out to realistically demonstrate aspects of the ignitability and burning behaviour of sample recycled waste provided. The containers are easy to ignite and once ignited continue to burn and spread flame, including involving the combustible contents. Local fires involving such recycled waste, whilst relatively modest compared to a flat fire, could produce significant heat and smoke within an enclosed stair, corridor or lobby landing. However, only a fraction of the total combustibles tend to be consumed in a typical waste fire, especially where stacked folded newspapers are present.

Measures could be taken to minimise the potential fire hazards, the foremost of which is to complete a premises-specific fire risk assessment in each case. The greatest hazards have been identified as those where there is/are 'single internal stairs, internal corridors or escape in one direction only'. In these types of location, general waste recycling in its present form is confirmed as unacceptable for fire safety reasons.

Further measures, subject to findings in a fire risk assessment, based initially on reducing the fire load could include consideration of the following: -

- Controlling the types of recycled waste, e.g., eliminating plastics from the contents;
- Minimising the combustible mass of the container, using flame-retardant containers, or using non-combustible containers;
- Adding fire safety measures to reduce the risk of ignition; and
- Adding fire safety measures to control or reduce the impact of fire, including consideration of the location of waste for collection.

The objective of the project to inform the sponsoring local authorities about the most appropriate means of providing convenient recycling services to high rise properties is considered to have been satisfactorily met.

10 Recommendations

Where there are single internal stairs, internal corridors or escape in one direction only, waste recycling in its present form is confirmed as unacceptable for fire safety reasons. Elsewhere, the existing practices may be justified to continue subject to a specific fire risk assessment taking account of local circumstances.

It is recommended that in premises with the former group of features, positive measures to reduce the fire risks should be considered as part of the fire risk assessment. In general these will mean: -

- Eliminating plastics from the contents;
- Minimising the combustible mass of the container, using flame-retardant containers, or using non-combustible containers;
- Reducing the risk of ignition by changing features of the premises / location; and
- Controlling or reducing the impact of fire by modification to the premises such as fire prevention, fire protection and / or fire safety design.

It is recommended that in premises where the fire risk, including the risk posed by doorstep waste recycling, is assessed as being reasonable (e.g. low risk) then the above measures should still be considered, supplemented by the following: -

- Crushing / compressing waste to minimise voids;
- Locating waste in places where the impact of fire would be minimised;
- Maintaining all fire precaution and fire prevention measures in good order;
- Controlling access to premises by security measures.

For new-build premises, it is likely that facilities for waste recycling will be taken into account and should not therefore be a fire safety issue.

It is recommended that a full fire risk assessment of every communal area should be completed to comply with the Regulatory Reform (Fire Safety) Order and that each assessment should take into account potential or actual waste recycling schemes. The objective of maximising waste recycling, including doorstep recycling, could then be promoted by policy or policies deriving from risk assessments. Variations in policy according to assessed risks would then help to maximise waste recycling.

Note: This report does not provide 'product approval' status but shows only the results of the material or sample tested.

Appendix

Fire risk assessments

A Photographs

B1 Westminster

B2 Hackney

A - Photographs

Photo 1 Hackney green bag HB1

Photo 2 Hackney food box

Photo 3 Westminster black basket

Photo 4 Westminster blue bag

Photo 5 Westminster blue sack WBS 6

Photo 6 Westminster blue sack WBS 7

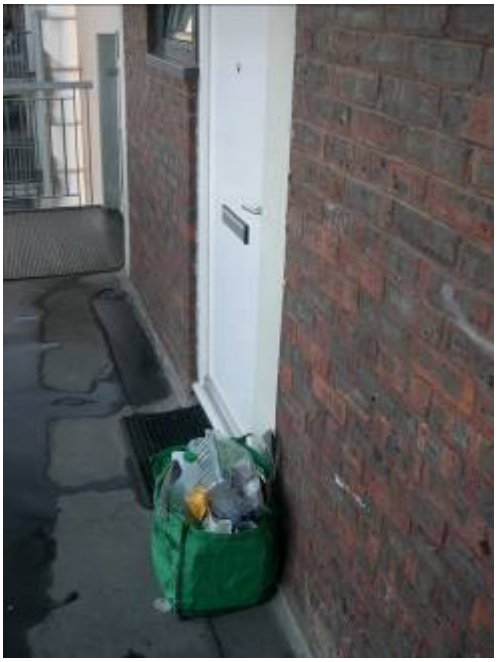

Photo 7 Open access balcony

Photo 8 Fully enclosed lobby landing

Photo 8 Hackney waste soon after ignition (~ 92% combustible – papers)

Photo 9 charred remains after 15 minutes newspapers mostly unburned in stack

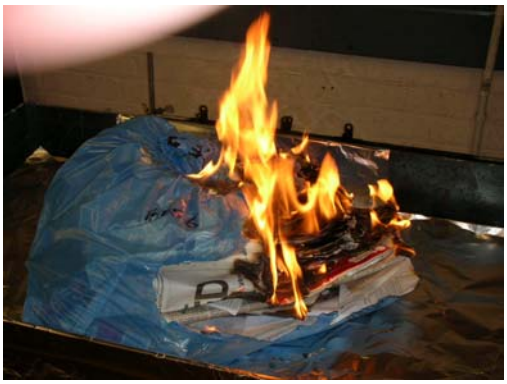

Photo 10 Westminster waste soon after ignition of the disposable sack

Photo 11 charred remain after 15 mins Tins and bottles spilled out; newspaper mostly unburned in stack